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## NOTES ON AMERICAN WILLOWS. IX.

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IN this article I shall discuss the species of two sections which were believed to be well known. If we, however, make a close examination of these species we find that our present knowledge of them is still superficial and only an attempt can be made to elucidate the synonymy, variability and the relationship of certain species. Some of these need a much closer study in the field before we can become acquainted with their forms and hybrids. There is also a great difficulty in referring some of these species to distinct sections. It is evident that many of my observations cannot be regarded as final and I desire to induce as many students as possible to take an earnest interest in the study of these difficult forms and to point out the defects in our present knowledge. I am sorry that I had to break off my studies too soon, as with more time I might have reached different conclusions with regard to certain of these species and forms. Nevertheless I hope that my notes contain some valuable hints for other salicologists. As for the preceding notes this study is mainly based on the collections mentioned in notes VII and VIII. I wish again to address my best thanks to all the gentlemen who have helped me.

### a. THE SPECIES OF THE SECTION DISCOLORES.

By recent authors the species of this section are mostly referred to the section *Capreae* which comprises some well-known European species. It may be that these American forms can be united with those of the Old World, but the more I become acquainted with American Willows the less I find, at least in most cases, a close relationship even with forms that are widely spread through Europe and Asia. Of course, I do not pretend to know enough of these species to draw final conclusions from the material I have studied. Our knowledge of the Asiatic Willows is, to-day, much too limited. But, in my opinion, we can gain less by uniting groups or species of different geographical distribution and of different morphological aspect than by keeping them apart. It is often difficult to describe the differences, and it is only by good sketches of the characters of the flowers and fruits and of other features that the reasons can be made clear why I prefer to regard many of the American Willows to be not so closely related to Euro-

pean or Asiatic species as one might judge by the conclusions of Andersson and more recent authors.

As may be seen by the synonymy given below Barratt referred *S. discolor* and *S. Scouleriana* to different groups but he, apparently, was not well acquainted with *S. Scouleriana*. On the other hand, he did, in 1840, recognize *S. discolor* as the type of a distinct section, of which the synonymy is as follows:

Sect. *Discolores* Barratt apud Hooker, Fl. Bor.-Am. II. 147 (1839), [*Discolorae*], pro parte, excl. *S. Richardsonii*; Sal. Am. sect. II. (1840). — Sect. *Capreae* Koch, De Salic. Eur. Comm. 31 (1828), quoad *S. prinoides* in nota. — Ball apud Coulter & Nelson, N. Man. Rocky Mts. Bot. 137 (1909). — Sect. *Cinereae* Barratt apud Hooker, Fl. Bor.-Am. II. 144 (1838), pro parte quoad *S. Scouleriana*, non Fries 1828. — Sect. *Cinerascentes* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 120 (1858), pro parte. — Sect. *Cinerascentes* vel *Capreae* Andersson in Svensk. Vet.-Akad. Handl. VI. 82 (Monog. Salic.) (1867); apud De Candolle, Prodr. XVI.<sup>2</sup> 215 (1868), pro parte, quoad *S. brachystachys* et *S. discolor*. — Sect. *Phyllicifoliae* Schneider, Ill. Handb. Laubh. I. 54 (1904), pro parte, quoad *S. discolor*.

To the same group seem to belong the Mexican species *S. paradoxa*, *S. oxylepis* and *S. Rowleei*. Not having seen enough material of these and not yet having been able to reach a final conclusion regarding the differences between certain forms of *S. Scouleriana* and *S. discolor* I do not give now a key for this group. The differences of these two species as pointed out by such an eminent salicologist as Ball (1909) do not always prove right. As a whole it is much easier to distinguish both in the herbaria by their appearance than to describe the characters by which they may be separated.

1. *S. discolor* Muhlenberg in Neue Schrift. Ges. Nat. Fr. Berlin, IV. 234, t. VI, fig. 1 (1803). — Willdenow, Spec. Pl. IV. 665 (1805). — Pursh, Fl. Am. Sept. II. 613 (1804). — Poiret in Lamarck, Enc. Suppl. VI. 57 (1817). — Elliott, Sketch Bot. II. 669 (1824). — Bigelow, Fl. Bost. ed. 2, 364 (1824). — Forbes, Salic. Wob. 279, fig. 147 (1892). — Hooker, Fl. Bor.-Am. II. 147 (1839), excl. var.  $\beta$  — Bebb apud Coulter & Watson, Gray's Man. ed. 6, 482 (1890). — Sargent, Silva, IX. 133, t. 478 (1896). — Schneider, Ill. Handb. Laubh. I. 54, fig. 11 u-u<sup>1</sup>, 26 a (1904). — Britton & Brown, Ill. Fl. I. 499, fig. 1187 (1896); ed. 2, I. 599, fig. 1472 (1913). — Robinson & Fernald, Gray's Man. 325, fig. 658 (1908). — Ball apud Coulter & Nelson, N. Man. Rocky Mts. Bot. 137 (1909); in Elys. Mar. III. 32, t. 7, fig. a (1910). — *S. conifera* Wangenheim, Beytr. Forstw. Nordam. Holzart. 123, t. 31, fig. 72 (1787), ex parte. — Willdenow, Berl. Baumz. 347 (1796); ed. 2, 455 (1811), ex parte; Sp. Pl. IV. 705 (1805), ex parte. — Pursh, Fl. Am. Sept. 612 (1814), ex parte; —? *S. sensitiva* Barratt, Sal. Am. no. 8 (1840). — *S. prinoides* Forbes, Salic. Wob. 79, t. 40 (1829). — *S. (phyllicifolia\*) discolor* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 123 (1858), pro parte. — *S. discolor virescens* Andersson in Svensk. Vet.-Akad. Handl. VI. 85 (1867). — *S. balsamifera intermedia* Barratt nom. nud. in herb. sec. Bebb in Bot. Gaz. IV.



191 (1879). — *S. squamata* Rydberg in Britton, Man. 317 (1901); in Britton & Brown, Ill. Fl. ed. 2, 1. 600 (1913).

The type of the widely spread eastern "Pussy Willow" has been well described by Muhlenberg and Willdenow, and also, in 1867, by Andersson as *S. discolor virescens*. It comprises the forms in which the branchlets are pubescent only when young, and the mature leaves become quite glabrous. The leaves are said to be "ovato-lanceolata utrinque acuta" by the author, or according to Willdenow who prepared the short diagnoses in Muhlenberg's article "oblonga obtusiuscula." The leaf figured on the plate seems to be only a half grown one. The type came from Lancaster, Pa.

This species was apparently first described by Wangenheim as *S. conifera* who probably confused the two species *S. humilis* and *S. discolor*. The pubescence of the leaves points to *S. humilis*, the habit to *S. discolor*. The figure given by Wangenheim is very badly drawn, and the name *conifera* refers to the galls which frequently are found on both species as well as on other Willows. Therefore it seems best to abandon entirely Wangenheim's name unless there can be found a type specimen which clearly proves the identity of his plant.

Michaux' *S. eriocephala* of 1803 the type of which came from Illinois represents the form with more or less persistently tomentose branchlets ("ramulis minutim tomentosus"). I shall say more of it later in dealing with Andersson's forms.

Pursh, in 1814, besides *S. discolor* described a *S. prinoides*. According to his statements it differs in its narrower more acute leaves, longer pedicels and longer styles. It is, however, almost impossible to judge from his description which form he had in mind. In Herb. Kew there is a specimen named *prinoides* by Borrer from Hort. G. Andersson of which a sketch is in Herb. G. It looks to me like typical *S. discolor*.

Barratt's varieties of 1840, *gracilis*, *obovata*, *minima*, and *attenuata*, are nomina nuda. I have only seen the type of f. *obovata*, which is nothing but *S. discolor typica*. The types of the other forms seem to be in Herb. Kew, and there are some sketches of them in Herb. G. Besides *S. discolor* Barratt mentions *S. conformis* Forbes. The native country of this form is not known; it may be a narrow leaved form of *S. discolor* identical with *S. prinoides* Pursh. The plant figured by Forbes (t. 410) as *S. prinoides* is the same form that Rydberg recently has described as *S. squamata*; it is nothing but a late flowering state of typical *S. discolor*, an opinion also held by Britton & Brown in 1913.

Of Barratt's no. "6. *Salix eriocephala* Michaux?" I have seen two specimens which are identical with var. *eriocephala* sensu Fernald (see later). Barratt also described a *S. crassa* of which I have seen the type. It, too, is *eriocephala*, and Carey in 1847 already made *S. crassa* a synonym of *eriocephala*. Barratt's *S. sensitiva* is, in my opinion, typical *S. discolor* or the same form which Pursh calls *S. prinoides*. Carey has put it with a question mark as a synonym of *S. discolor*.

The form which Carey took for *S. eriocephala* is uncertain to me. He said:

"Closely resembles the last [*S. discolor*]; but the aments are more compact and silky, and the scales rounder." He does not mention the pubescence, and cites as synonyms "*S. prinoides* Pursh? *S. crassa*, Barratt."

Andersson (1858) said very little of *S. discolor* making it a quasi form of *S. phylicifolia*. In 1867, he dealt thoroughly with it. His figure 49 on t. 5 represents rather short-petioled leaves loosely pubescent beneath, and a glabrous female flower which rather agrees with that of *S. cordata* but unfortunately a good many of Andersson's figures are very inaccurately drawn. He divides *S. discolor* in the three forms: *rigidior*, *latifolia* and *virescens*. The last is identical with Muhlenberg's type in Herb. Willdenow, and represents a form with "foliis angustius lanceolatis." Andersson does not mention it again in the Prodrum (1868). Here he also changed the two other forms of 1867. The name *rigidior* is not used again but is apparently changed to *angustifolia*. This form, however, is, in my opinion, the same as var. *prinoides* of recent authors. The name *rigidior* seems the oldest, therefore this variety has to be called var. *rigidior* (see later).

Andersson's var. *latifolia* (1867) is retained in 1868, but in the Prodrum he excludes the hairy forms keeping them separate as "*3 hirsuta*" of which the type is said to be in "H. C. Vindob." Unfortunately I have not been able to find it in the Herbarium at Vienna.

In 1867 Andersson also mentions two subspecies: \**S. eriocephala* and \**S. prinoides*. In 1858 (Öfv. Svensk. Vet.-Akad. Förh. xv. 117) he said of *S. eriocephala*: "E *Salicibus americanis* haec mihi valde obscura" placing it next to his *irrorata*. He dealt extensively with specimens which he had received as *S. eriocephala*, *prinoides*, and *conifera* but his statements are of little value. In 1867 he made two varieties of his subspec. *eriocephala*: *parvifolia* and *rufescens*. The type of *parvifolia* was collected by Bourgeau "Ad flumen Saskatchewan." Without having seen it, I cannot decide whether this really is a form of *S. discolor* or of *S. Bebbiana*. Andersson himself says: "facie *S. vagantis rostratae*." The var. *rufescens* came from "America occidentalis," and it belongs to *S. Scouleriana*. Andersson adds to his description the following remark: "Haec forma *S. brachystachyae-Scoulerianae* similis est, ab ea attamen amentis multo longioribus magisque laxifloris capsulis demum longius pedicellatis differt." See also *S. Scouleriana*. In 1868, Andersson does not mention again these two forms. He makes *S. eriocephala* a var.? *eriocephala* of *S. discolor* and says: "In herbariis variis formas indubie identicas nunc *S. discolor* nunc *S. eriocephala* promiscue signatas vidi, nec e scriptis auctorum differentias ullas extricare potui, nisi jam allatas, e forma squamarum desumtas sed viles."

The subspecies *S. prinoides* Andersson (1867) is founded on Pursh's *S. prinoides*. Andersson says: De hac species iterum incertus sum; e descriptione a praecedentibus et omnibus *S. cinerascens* differret "stylo elongato" et forsitan melius *S. phylicifoliae* affinis censeretur; specimina tamen quae plurima vidi, etiam in eo *S. discolor* magis revocaberunt, quod styllum ullum subproductum vix observare possem. Pursh ipse de hac dicit "resembles *S. discolor*." Nuttall eam cum *S. discolor* cum ? con-



jungit, ut etiam Asa Gray alique." In the Prodrusus, Andersson treats *S. prinoides* in the same manner as *S. eriocephala*, that is as a var. ? *prinoides* of *S. discolor*, and remarks: "Obit praecipue memorabilis utpote quae, regiones magis septentrionales Americae orientalis praecipue inhabitans, forma capsularum ad *S. humilem* transitum quadammodo efficit."

So far as I am acquainted with *S. discolor* there seem to occur at least two rather distinct varieties: one with "ramulis foliisque ab initio glabris vel tantum novellis pubescentia grisea fulvaeque plusminusve densa cito evanescente obtectis"; the second with "ramulis novellis dense tomentosis etiam annotinis floriferisque plusminusve (partim) tomentosis, foliis (saltem subtus) plusminusve griseo-fulvaeque pilosis sed adultis saepe omnino glabrescentibus." The first one in my opinion, is typical *S. discolor*. There may be a forma glaberrima of it to which certain forms from the northeast ought to be referred. To the typical variety apparently belongs as a form with narrower leaves and with a somewhat longer style *S. prinoides* sensu stricto. The correct name for it, as already stated, seems to be *S. discolor* f. *rigidior* Andersson in Svensk. Vet.-Akad. Handl. vi. 84 (1867) (*S. prinoides* Pursh, Fl. Am. Sept. ii. 613 (1814). — Bebb apud Watson & Coulter, Gray Man. ed. 6, 482 (1890). — Ball in Bot. Gaz. LX. 398 (1915) et auct. al. ex parte. — ? *S. conformis* Forbes, Salict. Wob. 47, t. 24 (1829). — Barratt, Sal. Am. no. 5 (1840). — *S. discolor* \*\* *S. prinoides* Andersson in Svensk. Vet.-Akad. Handl. vi. 86 (1867). — *S. discolor* 2° *angustifolia* Andersson in De Candolle, Prodr. xvi.<sup>2</sup> 225 (1868). — *S. discolor* γ ? *prinoides* Andersson, l.c. 225, an tantum pro parte? — *S. discolor* var. *prinoides* auct. al. pro parte maxima. — *S. homonyma* Gandoger in Flora LXV. 228 (1882).

The second variety with tomentose branchlets is the same as *S. eriocephala* Mich. and as var. *eriocephala* of most authors. The oldest name that has to be used seems to be *latifolia* of Andersson, therefore the synonymy may be indicated as follows: *S. discolor* var. *latifolia* Andersson in Svensk. Vet.-Akad. Handl. vi. 84 (1867) — *S. eriocephala* Mich. Fl. Bor.-Am. ii. 225 (1803). — Carey apud Gray, Man. 426 (1848); ed. 2, 414 (1856); ed. 3, 414 (1862); ed. 4, 414 (1863). — Britton, Man 317 (1901.) — *S. discolor* \* *S. eriocephala* Andersson in Svensk. Vet.-Akad. Handl. vi. 85 (1867), excl. var. — *S. discolor* 1° *latifolia* Andersson in De Candolle, Prodr. xvi.<sup>2</sup> 225 (1868). — *S. discolor* β ? *eriocephala* Andersson, l.c. 225. — *S. discolor* var. *eriocephala* Bebb apud Watson & Coulter, Gray's Man. ed. 6, 482 (1890) et auct. al. pro parte maxima. — *S. eriocephala amplifolia* Rydberg apud Britton, Man. 317 (1901).

There is a very obscure form mentioned by Andersson as *S. commixta* Andersson in Svensk. Vet.-Akad. Handl. vi. 84 (1867) in textu et apud De Candolle, xvi.<sup>2</sup> 225 (1868) in textu, nomen nudum. In the last place Andersson says: formae quam *S. commixtam* appellavimus eximie similis, sed capsulae longius pedicellatae et stylus nullus!" Probably a hybrid.

Gandoger, Fl. Europ. xxi. 167 (1890), has made the following subspecies of *S. discolor*: *S. canadensis* (Type: lg. Fowler, Bass River, Canada), *S. imponens* (type: lg. Babcock, Riverside, Ill.), *S. Michauxiana* (type: lg.

Congdon, Warwick, R.I.), *S. stenocarpa* (type: lg. Pierron, Westmoreland, Pa.), and *S. stephanostigma* (type: lg. Congdon, Warwick, R.I.); their identity is uncertain to me not having seen the types.

*S. discolor*, including its main varieties, is widely distributed from New Foundland (where the glabrous form mentioned above occurs), Nova Scotia (Colchester, Haunts and Yarmouth Counties), Prince Edward Island (Prince and Summerside Counties), New Brunswick (Charlotte, Sunbury, Westmoreland, Kent and Restigouche Counties), Maine (Penobscot, Washington, Cumberland and York Counties), New Hampshire (Grafton and Cheshire Counties), Vermont (Caledonia, Addis, Rutland and Lamoille Counties), Massachusetts (Worcester, Berkshire, Hampshire, Essex, Middlesex, Suffolk, Norfolk, Bristol and Barnstable Counties), Connecticut (Fairfield and New London Counties), Rhode Island, New Jersey (Sussex, Passaic, Morris, Middlesex Essex and Bergen Counties), Pennsylvania (Lancaster and Berks Counties), Kentucky (locality uncertain, forma ad var. *latifolium* vergens, ex Herb. Chapman in M.), Ohio (Cuyahoga and Richland Counties), Indiana (Wells, Randolph, Shelby, Marion, Knox, White, Newton and Lake Counties), Illinois (Coos, Stark, Henderson, Lake and Winnebago Counties), Michigan (Wayne, Marquette, St. Claire and Houghton Counties, Isle Royale), Minnesota (Minneapolis County), Wisconsin (near Madison), Iowa (ex Ball in Proc. Iowa Acad. Sci. VII. 148 [1900]: Dickinson, Emmet, Cerro Gordo, Fayette, Delaware, Story, Clinton, Johnson, Scott and Henry Counties), Northeastern Missouri (Clark County), S. Dakota (Black Hills, see Ball in Bot. Gaz. LX. 398 [1915], partly doubtful to me), N. Dakota (Benson and Cumberland Counties), Saskatchewan (Qu'appelle, Quill Plain, Saskatoon and Cumberland Districts, and on Assiniboine River), E. Ontario (Carleton and Glengerry Districts), Manitoba (Lake Winnipeg), Quebec (? Pontiac, Algonquin, Ottawa, La Prairie, Stanstead, Chateaugay, Megantic, Rimouski and Gaspé Districts, Mingan Islands and Magdalen Islands).

2. *S. Scouleriana* Barratt apud Hooker, Fl. Bor.-Am. II. 145 (1839), excl. foliis. — Howell, Fl. N. W. Coast, 619 (1902). — Piper in Contrib. U.S. Nat. Herb. XI. 214 (Fl. Wash.) (1906). — Ball apud Coulter & Nelson, N. Man. Rocky Mts. Bot. 138 (1909). — Rydberg, Fl. Rocky Mts. 195 (1917). — *S. Hookeriana* Nuttall, Sylva N. Am. I. 64 (1843), pro parte, non Barratt. — *S. flavescens* Nuttall l. c. 65, non Host, 1828. — Bebb in Bot. Gaz. VII. 129 (1882). — Macoun, Cat. Can. Pl. II. 448 (1886); IV. 357 (1888). — *S. stagnalis* Nuttall, Sylva N. Am. I. 66 (1843). — *S. brachystachys* \* *S. Scouleriana* Andersson in Svensk. Vet.-Akad. Handl. VI. 83, t. 5, fig. 48 [mala] (1867), excl. var. *crassijulis*. — ? *S. discolor* \* *S. eriocephala rufescens* Andersson, l. c. 85 (1867). — *S. Nuttallii* Sargent in Gard. and For. VIII. 463 (1895), excl. var. — *S. Scouleriana* var. *flavescens* Henry, Fl. S. Brit. Columb. 98 (1915).

The type of *S. Scouleriana* has been collected by Dr. Scouler "on the Columbia." According to Piper (Fl. Wash. 13) Scouler's "collections were



confined to the single season of 1825. During April and May he collected with Douglas mainly at the mouth of the Columbia and at Fort Vancouver." The type, of which I saw fragments and a photograph from Herb. Kew, has almost ripe fruits and young leaves. It probably has been collected in the beginning of May. Barratt also cites specimens of Tolmie from Vancouver. There is one from Barratt's herbarium in Herb. G. It consists of a fragment of a branchlet with female flowers and very young leaves, and of a male fragment which belongs to *S. sitchensis*. In the original diagnosis of *S. Scouleriana* the leaves, too, have been described but apparently there is no sterile type or co-type with mature leaves in existence, and Andersson states (1858): "in herbario Hookerii vidi specimina duo florentia ad *S. brachystachyam* Benth. absque ullo dubio pertinentia, et specimen *S. sitchensis* Sans." In 1867 he says, that these three specimens are "in una eademque charta agglutinata." The photograph before me only shows a specimen collected by Scouler which I regard as the type. The description of the leaves in Hooker's Flora certainly fits those of *S. sitchensis*; Barratt, therefore, must have had a specimen of this species with mature leaves which has been lost. Piper remarks that "Barratt's original types seem to be lost."

Andersson, in 1858, rejected the name *S. Scouleriana* because it is founded on two different species. There is however no reason to suppress the name, as the female specimen represents a good species. There is a possibility, already mentioned by Piper, that Scouler only collected a fruiting specimen, and that the mixture with *sitchensis* is due to Tolmie's plant of which I have spoken. Barratt and Hooker do not describe male flowers, and probably they have not seen Tolmie's male specimen or recognized that it belongs to a different species.

*S. Scouleriana* sensu stricto was described again by Nuttall in 1843 as *S. flavescens* and *S. stagnalis*. Of *S. flavescens* there is a co-type in Herb. G. consisting of one fragment with fruits and another with mature leaves. The first bears the label "*Salix* \* *flavescens*. R. Mts. by streams." The young leaves partly show a thick flavescent-opaque tomentose pubescence on the lower surface but appear to become later rather glabrous. They are oboval but the apex is wanting. The small leaflets of the fruiting ament are almost glabrous above and flavescent-silky beneath. The other fragment with mature leaves which are almost glabrous and brownish beneath might be taken for a co-type of Nuttall's second species, *S. stagnalis*. The oboval leaves measure up to 4:2 cm. The twigs of the season are finely pilose, the one year old branchlets glabrous and purplish. The type of *flavescens* came from the Rocky Mountains while that of *stagnalis* was collected on "the banks of the Oregon" Columbia. There is another specimen in Herb. G. collected by Nuttall "Columbia-woods," and named "*Salix cinerea* \* *lagopus*." The name *cinerea* has been crossed out later, and above it is written *Hookeriana* Barratt. This seems to be *S. Hookeriana* Nuttall (Sylva, p. 64) sensu stricto. The specimen has folia utraque acuta, ad 10:7 cm. magna. The pubescence is the same as in the hairy form mentioned below, the aments are in bad condition.

The name *S. stagnalis*, so far as I know, has later been mentioned only by Bebb (1879) with a ? as a synonym of *S. flavescens*; it is not to be found in Andersson's or Ball's writings or in the Floras of Howell or Rydberg. Nuttall describes the leaves as "oblongo-lanceolatis, obtusis integerrimis basi cuneatis," and "scattered beneath with a minute brown pubescence, which communicates a somewhat rusty appearance to the leaves; they are about  $1\frac{1}{2}$  inches long and  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch wide, and in the bud covered with long silky hairs."

In 1857, Bentham's *S. brachystachys* was published from *prope* Monterey in California, and a little later (1858) Andersson described his *S. capreoides* as well as Bentham's species. Bentham's type is Hartweg's No. 1957 of which I have seen a photograph and a fragment from Herb. Kew, and a co-type in Herb. G. Andersson's species is based on Coulter's No. 656 (he quotes the number in 1867) to which he adds in 1858, "et Oregon (Herb. Hook.)" without indicating the collector. This specimen may be identical with Cooper's male piece from Astoria which I have seen in Herb. G. Andersson has written on this sheet "*S. (brachystachys) capreaeformis*." The specimen belongs to the pubescent form mentioned later. In 1867 and 1868 Andersson does not again mention this specimen.

In my opinion, the types of *S. brachystachys* and *S. capreoides* belong to the same form. Bebb, in 1879, quotes both names as synonyms but he says (1882) that both have to be regarded as "striking modifications" of the variety (of *S. flavescens*) which he calls *Scouleriana*.

Andersson's treatment of these intricate forms has to be studied very carefully to understand the confusion which resulted from it. He ignored Nuttall's names *S. flavescens* and *S. stagnalis*, and he, too, rejected *S. Scouleriana* as a specific name. In his monograph (1867) he gave the following arrangement of forms under *S. brachystachys* to the type of which he referred specimens of Hartweg, Coulter and Scouler: subspec. \* *S. Scouleriana* with the forms — *tenuijulis* And. (syn. *S. Scouleriana* Barr.) and — *crassijulis* And. (syn. *S. capreoides* And.) In 1868, Andersson repeats this but changes the subspec. *Scouleriana* to var.  $\beta$  *Scouleriana* with 1° *tenuijulis* and 2° *crassijulis*. His f. *tenuijulis* is nothing but typical *S. Scouleriana* because he quotes as types the specimens of Scouler and Tolmie. In 1868 he adds a specimen collected by Wrangel in California which I did not see, and which seems to belong to what I take for typical *flavescens*. Andersson's var. *crassijulis* is identical with his *S. capreoides*, and therefore with *S. brachystachys* sensu stricto.

In 1879<sup>1</sup> Bebb commenced his investigation of *S. Scouleriana*, rejecting this name and taking up *S. flavescens* Nutt. When he, in 1882, again dealt with the species of California he proposed to keep the name *S. flavescens* for the mountain form (Rockies, Sierra Nevada, mountains of Oregon and Washington), and proposed that the form of the coast, "should be arranged as a variety of that species for which the old name *Scouleriana* might well

<sup>1</sup> The reprint of Bebb's treatment of the Willows of Watson's Fl. Cal. appeared in 1879, though the second volume of Watson's work was not published until 1880.



be retained, and under which *S. brachystachys* Benth. and *S. capreoides*, And., would be placed as striking modifications." He does not say how to distinguish the last two forms but he states that they "exhibit an intricate diversity of forms which defy the drawing of any line between them." In 1895, Bebb decided not to use the name *Scouleriana* at all, and said "we, therefore, fall back upon *S. capreoides*, Anders., as next in point of date." Strange to say he did not apply the older name *S. brachystachys* which he himself had cited in 1879 as a synonym. By this Bebb almost more than Andersson added to the confusion in the nomenclature of the group of difficult forms which are now referred to *S. Scouleriana*. In 1895, Sargent stated that the name *S. flavescens* Nutt. could not be used on account of the older *S. flavescens* Host (of 1828), and he proposed the name *S. Nuttallii* overlooking entirely *S. stagnalis* Nuttall, and not considering *S. brachystachys* Bentham, while he transferred var. *capreoides* to *S. Nuttallii*. In his Silva (1896) Sargent kept *S. Nuttallii* with var. *capreoides* and var. *brachystachys* which he said was the "most abundant Willow in western Washington and Oregon." In doing so he used the name *brachystachys* for what for the most part is typical *Scouleriana* which is pictured on his plate 483.

Ball in dealing with our species in 1899, kept the name *S. flavescens*, and rejected *Scouleriana*. Besides the typical *flavescens* of the mountains he distinguished like Bebb the form of the coast as var. *capreoides* sensu Bebb. Coville in 1901 used the name *Nuttallii* "until a critical revision of these willows has been made." Howell (1902) and Piper (1906) took up the name *Scouleriana* again, and Ball followed them in 1909 and 1915. The last valuable remarks on this species were made by J. K. Henry (1915) whose treatment I shall discuss later.

From what I have already explained we may draw the conclusion that the oldest name is *S. Scouleriana*, and that if we reject it on account of its being a mixture of two species, *S. stagnalis* Nutt. would be the next oldest name to adopt. There is however no valid reason to abandon Barratt's name. Regarding the nomenclature of the varieties we have to adopt principles in accordance with the international rules.

The type of *S. Scouleriana* came from the northern coast (Vancouver), and that of *S. brachystachys* and *S. capreoides* from the Californian coast. If we separate, as Bebb and Ball (in 1899) did the mountain form (which is *S. flavescens* sensu stricto), this ought to be called *S. Scouleriana flavescens* because all the other varieties hitherto made including var. *tenuijulis* and var. *crassijulis* And. refer to the coast form. Unfortunately, Henry, in 1915, made the combination *S. Scouleriana flavescens* for a form which is "common on V.I."; therefore, his name does not apply to the mountain form.

*S. Scouleriana* has a wide range extending from the Yukon Territory through British Columbia and southern Alaska (to Cook Inlet), to the Black Hills in South Dakota, Colorado, New Mexico, and Arizona, and along the coast to southern California. It is easy to understand that within this range the species must show remarkable degrees of variation. Geographically these

forms are, however, not clearly separated. The variability seems to be the same in different localities, and Ball rightly states (1915) that it is "an immensely variable species especially as to foliage." J. K. Henry, having in mind in 1915 only the variations of typical *S. Scouleriana* in southern British Columbia, likewise asserts that the species is "very variable, presenting many ill defined forms." Apparently he made careful observations of these forms in the field, and besides the type he distinguished a var. *flavescens* (Nutt.). According to him the type is a small leaved form (folia 2.5-5 cm. longa) while his var. *flavescens* represents large leaved forms (folia 5-10 cm. longa). Of the last he says: "These are two recognizable forms of this var. (a) leaves prevailing obovate and obtuse, 4-6 cm. broad, common on V.I. (b) Leaves prevailing oblanceolate and acute; but the two intergrade." In 1899 Ball as already stated was inclined to separate the coast form from that of the mountains, the last being identical with the typical *S. flavescens*; in 1909, however, he only says: "Forms with short stout aments may be referred to var. *crassijulis* Anders." but he does not mention other forms.

It is extremely difficult to analyze correctly the different forms of such a variable species. It would be an easy task to describe as many varieties as have for instance been made of the European *S. nigricans*, but nothing could be gained by doing this. We need many more careful observations in the field, and much more material collected from the same individual at different seasons of the year from every part of its habitat. We are far from having a good idea of the variability of the individual plant and of its adaptability to certain ecological and climatic conditions. The differences in the flowers (size of the aments, glabrousness or pubescence of the filaments, size and color of the anthers, length of the stigmas and of the style, length of the pedicel, etc.) do not seem to afford very reliable characters on which to base varieties or even forms. The pubescence of the twigs and leaves which often looks so distinct, at least in the herbarium, is changeable in the same plant according to the season or locality; and I am far from being able to decide the taxonomic value of these variations.

It is not less difficult to apply certain names to certain forms. As may be seen by what has been said and by the synonymy given above, a good many combinations have already been made. Several of them apply to identical forms. The oldest varietal name var. *tenuijulis* Anders. is synonymous with typical *S. Scouleriana*, while var. *crassijulis* Anders. can only be used for the form which is identical with the typical *S. capreoides* which moreover is nothing but *S. brachystachys* Benth.

I have already mentioned that the name var. *flavescens* has been applied by Henry in 1915 to a form which apparently is not the *S. flavescens* of Nuttall, but probably typical *S. Scouleriana* or at least a form of it. Nuttall's *flavescens* may be a form of the mountains which, at present, I cannot clearly distinguish from the northern coastal form. Nuttall's *S. stagnalis* from the Columbia in Oregon seems to agree with typical *S. Scouleriana*, Henry's small-leaved form. Here the leaves are indeed, as Nuttall says, "scattered



beneath with a minute brown pubescence" while of *S. flavescens* Nuttall states: "For a good while the leaves still remain downy, particularly on the under surface, which is tinged also with pale yellow." After all, however, I cannot find that both kinds of pubescence indicate two really different forms because in several specimens before me the older (lower) leaves agree with the description of *S. stagnalis*, while the younger (upper) leaves have the pubescence of *S. flavescens*.

Among the specimens from the Yukon Territory there are some with very tomentose branchlets of the preceding year of which the (not yet quite mature) leaves bear a thick soft pubescence on the lower surface. On other specimens the pubescence of the branchlets seem to disappear, and the leaves soon become glabrescent while, too, there are forms with quite glabrous branchlets of the previous year and with quickly glabrescent leaves which finally show only a thin pubescence of minute gray and brownish hairs on the lower surface.

The extremes of those forms are indeed very unlike each other, but there are apparently many intermediates between them. Henry expressly states that the leaves "in moist situations often remain tomentose beneath, in drier becoming silky and finely brown beneath." Piper, already in 1906, emphasized the fact that *S. Scouleriana* is "an exceedingly variable species as to foliage and habit, but in the floral characters apparently not capable of being divided."

The main variation in the female flowers is in the length of the style which mostly is somewhat hairy, and in the length of the stigmas which varies from 1 to 2 mm. We do not yet know whether these variations correspond with others in the leaves or in other parts of the plant. Sometimes the pedicel is as long as the bract, but there is no other indication of an influence of *S. Bebbiana*. The male flowers seem normally to have glabrous filaments or rarely a few hairs at their base. Whether forms with filaments hairy up to half of their length (which seems to be often the case with late flowers) can be separated I have not been able to make out. Of the color of the anthers Miss Eastwood says in a field note of the Yukon forms: "Some bushes have yellow anthers and some have red. The former have yellow catkins before the anthers open and the latter red. The same difference in color holds in the pistils." I have never seen purple anthers in the forms of other regions except in one specimen (L. E. Smith, no. 574) from Sisson, California.

At present I do not retain more than two varieties of *S. Scouleriana*. One is the type (*S. brachystachys Scouleriana tenuijulis* Andersson) apparently figured by Sargent (Silva, t. 482) which according to the type specimen is characterized as follows: ramulis floriferis dense villosulo-tomentosis, foliis juvenilibus distincte ferrugineo-pilosis, amentis femineis submaturis circ.  $3\frac{1}{2}$  cm. longis, circ. 12 mm. crassis, ovarii stylo circ. 0.5 mm. longo plusminusve distincto, stigmatibus siccis circ. 1 mm. longis, pedicellis glandulam 2-plo superantibus, circ. 1.5 mm. longis, fructibus maturis circ. 6-7 mm. longis. As to the leaves I can only say that while they seem to become very

glabrous when mature they still show a minute brown pubescence on the lower surface. The branchlets are more or less slender, brown-red, and those of the preceding year may be rather glabrous or show only remnants of pubescence. The male flowers apparently have glabrous filaments like those of specimens collected by Spreadborough at Departure Bay, V.I.

Of this typical variety forms with very small oblanceolate leaves and others with very short and small aments are frequently found. Besides these there is the form called var. *flavescens* by Henry which is as I have already explained probably not Nuttall's *flavescens*. I have named it in different herbaria var. *poikila*<sup>1</sup> but I am not sure whether it really is more than an ecological form. It is characterized by foliis superioribus saepissime ultra 6 ad 10-12 cm. longis, oblongioribus saepe utrinque acutis, subtus magis tomentosis vel griseo-pilosis, amentis satis crassioribus longioribusque, stigmatibus plusminusve distincte sessilibus 1.5-2 mm. longis. Such forms I have seen from Washington, British Columbia, and the Yukon Territory. There are somewhat similar specimens before me from Utah (Ogden Canyon). Very often offshoots of the typical form show the same characters of the leaves.

A more distinct variety seems to be

*S. Scouleriana* var. *crassijulis*, comb. nov. — *S. brachystachys* Benth. Pl. Hartweg. 336 (1857). — (*S. Caprea* \*) *Capreoides* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 120 (1858); in Proc. Am. Acad. iv. 60 (Sal. Bor.-Am. 14) (1858); in Walpers, Ann. Bot. v. 748 (1858), pro specie. — *S. brachystachys* \* *S. Scouleriana crassijulis* Andersson in Svensk. Vet.-Akad. Handl. vi. 83 (Monog. Salic.) (1867). — *S. brachystachys* β *Scouleriana* 2 *crassijulis* Andersson apud De Candolle, Prodr. xvi.<sup>2</sup> 225 (1868). — *S. flavescens* var. *capreoides* Bebb in Gard. & Forest, viii. 373 (1895). — *S. Nuttallii* var. *capreoides* Sargent in Gard. & Forest, viii. 463 (1895). — *S. Nuttallii* var. *brachystachys* Sargent, Silva, ix. 142, t. 483 (1896). — *S. Scouleriana* var. *brachystachya* (!) Jones, Willow Fam. 15 (1908). — It may be briefly characterized as follows: frutex vel arbor ramis satis brevibus divaricatis tortuosis, etiam ramulis vetustioribus plusminusve tomentellis; ramuli hornotini annotinique satis tomentosi; folia satis parva, obovata, vix ultra 6.3 cm. magna, subtus plusminusve dense pubescentia (saltem juniora, adultiora satis rufescenti-pilosa); amenta fructifera ad 4:1.7 cm. magna, styli subnulli stigmatibus circ. 1.5 mm. longis ultra 4-plo breviores; filamenta glabra vel basi sparse pilosa; fructus fere 8 mm. longi pedicello ad 2 mm. longo excluso.

This variety seems to be restricted to California (Santa Cruz, Monterey, and probably San Bernardino County) but some forms from Oregon (for instance Sheldon's no. 11627/8, Portland) look very similar. There may be intermediates between var. *typica* and var. *crassijulis* and the forms of the Rocky Mountains from British Columbia to New Mexico and of the Sierra Nevada which represent the typical *S. flavescens*. In 1899 Ball distinguished the typical *S. flavescens* from var. *capreoides* Bebb which is our

<sup>1</sup> Derived from ποικίλος, intricate, changeable.



var. *crassijulis*, and the typical *S. Scouleriana*, but later he apparently changed his mind.

I do not wish by any means to make a definite statement as to the possibility of circumscribing with sufficient accuracy the varieties mentioned. The purpose of my lengthy explanations is only to show how little we really know and how difficult it is to come to a proper understanding of a species like *S. Scouleriana*. I have seen material from the following states and counties: Alaska (Cook Inlet, Admiralty, Skagway and Guard Island); Yukon Territory (Dawson to Lake Bennett); British Columbia (Vancouver Island, New Westminster, Yale, Kootenay and Cassiar Districts); Alberta (Rocky Mountain District); Saskatchewan (Cypress Hills); Washington (San Juan Islands, King, Pierce, Klickitat, Douglas, Wallawalla, Adams, Columbia, Kittitas, Whitman, Spokane, Whatcom and Chelan Counties); Oregon (Clatsop, Multnomah, Morrow, Marion, Polk, Klamath, Coos, ? Jackson and Josephine Counties); California (Humboldt, Siskiyou, Nevada, Plumas, Placer, Amador, Madera, Monterey, Santa Clara, Marin, Santa Cruz, Alameda, ? Mendocino, Fresno, San Bernardino and Inyo Counties); Montana (Missoula, Deer, Lodge and Gallatine Counties); Wyoming (Yellowstone Park, Fremont, Sweetwater, Sheridan, Crook and Albany Counties); South Dakota (Lawrence County); Nevada (Ormsby and ? Washoe Counties); Colorado (Laramie, Boulder, Clear Creek, Teller, Ouray, Costilla, Montrose and La Plata Counties); New Mexico (Otero, Sierra, Union and Santa Fé Counties), and Arizona (Coconino and Pima Counties).

3. *S. paradoxa* Kunth in Humboldt & Bonpland, Nov. Gen. Pl. II. 20 (1817). — This Mexican species has been dealt with in my first article in Bot. Gaz. LXV. 35 (1918). It needs further observation.

4. *S. oxylepis* Schneider, Bot. Gaz. LXV. 34 (1918). — *S. latifolia* Martens & Galeotti in Bull. Acad. Brux. x. pt. 1, 344 (1843), non Forbes (1829). — This is another little known Mexican species.

5. *S. Rowleei* Schneider in Bot. Gaz. LXV. 31 (1918). — *S. cana* Rowlee l. c. XXVII. 137 (1899), pro parte, non Martens & Galeotti. — This is a third Mexican species of close relationship to the other two, and like these very badly known. Those three species apparently belong to the same group as *S. discolor* and are rather closely related to *S. Scouleriana*. Not having seen enough material I at present refrain from explaining the differences between the Mexican and northern species.

#### b. THE SPECIES OF THE SECTION GRISEAE.

This section was established by Borrer who referred to it as the only species *S. petiolaris* Smith. Barratt enlarged it to contain, in addition to *S. petiolaris*, "*S. rosmarinifolia* L." which is *S. sericea* Marshall; *S. coactilis* Fernald is closely related to the last. The two other species added here: *S. humilis* and *S. tristis* were placed by Barratt (1840) in his section *Cinereae* which name he used in 1838 (apud Hooker) for species like *S. candida*, *S. Drummondiana* and others which I have dealt with before. The name,

however, had been applied by Borrer in 1830 to a group of European Willows which to-day is known as sect. *Capreae*.

I do not wish to say that the group of *S. petiolaris* and *S. sericea* and that of *S. humilis* are so closely connected that they have to be united in one section but there is a great similarity in the floral characters of both.

Possibly even *S. Lemmonii* might be placed in this section, but it seems in some respect to have a closer relationship with the species of section *Fulrae* of which I shall speak in my next note. The synonymy of section *Griseae* is as follows:

Sect. *Griseae* Borrer apud Hooker, Brit. Fl. 419 (1830). — Barratt apud Hooker, Fl. Bor.-Am. II. 148 (1839); Sal. Am. (1840) sect. 3. — Sect. *Cinereae* Barratt, l. c. sect 1, non Borrer 1830, nec Barratt 1838. — Sect. *Argenteae* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858), pro parte, non Koch. — Sect. *Argenteae* s. *Repentes* Andersson in De Candolle, Prodr. xvi.<sup>2</sup> 233 (1868), pro parte. — Sect. *Repentes* Zabel apud Beissner, Schelle et Zabel, Handb. Laubholz-Ben. 31 (1903). — Sect. *Argenteae*, subsect. *Repentes* Schneider, Ill. Handb. Laubh. I. 64 (1904), pro parte.

In a key I shall show later the differences between the groups and also between the species.

1. *S. sericea* Marshall, Arbust. Am. 140 (1785); Cat. Arb. Arbriss. 223 (1788). — Muhlenberg in Neue Schr. Ges. Nat. Fr. Berlin, IV. 240, t. VI. fig. 8 (1803). — Carey apud Gray, Man. 426 (1848). — Andersson in Proc. Am. Acad. IV. 66 (Sal. Bor.-Am. 21) (1858). — Bebb apud Watson & Coulter, Gray Man. ed. 6, 483 (1890). — Macoun, Cat. Am. Pl. 455 (1886). — Britton & Brown, Ill. Fl. I. 499, fig. 1188 (1896); ed. 2, 598, fig. 1469 (1913). — Ball in Proc. Iowa Acad. Sci. VII. 149, t. 12, fig. 10 (1900); in Elys. Mar. III. 30, t. VI. fig. b. (1910). — Schneider, Ill. Handb. Laubh. I. 64, fig. 15 g, 21 m-m' (1904). — Britton, Man. 318 (1905). — Porter, Fl. Penn. 101 (1903). — Griggs in Proc. Ohio Acad. Sci. IV. 302, t. 11 (1905). — Robinson & Fernald, Gray's Man. ed. 7, 326, fig. 662 (1909). — Von Seemen apud Ascherson & Graebener, Syn. Mitteleur. Fl. IV. 130 (1909). — Schaffner in Bull. Ohio Biol. Surv. I. 199 (Cat. Ohio Vasc. Pl.) (1914). — *S. grisea* Willdenow, Sp. Pl. IV. 699 (1805). — Pursh, Fl. Am. Sept. II. 616 (1814). — Poiret in Lamarek, Enc. Suppl. VI. 64 (1817). — Barratt, Sal. Am. no. 10 (1840). — Koch, De Sal. Eur. Comm. 21 (1828), excl. var. — Loudon, Arb. Brit. III. 1533 (1838). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858). — *S. argentea* Dumont de Courset, Bot. Cult. ed. 2, VI. 395 (1811), doubtful. — ? *S. rosmarinifolia* Pursh, Fl. Am. Sept. II. 612 (1814), non Linnaeus. — Elliott, Sketch Bot. II. 668 (1824). — *S. pennsylvanica* Forbes, Salict. Wob. 189, t. 95 (1829). — *S. petiolaris* var. *grisea* Torrey, Fl. N. York II. 207 (1843). — *S. petiolaris* \* *S. sericea* Andersson in Svensk. Vet.-Akad. Handl. VI. 110, t. VI. fig. 61 \*\* (Monog. Salic.) (1867). — *S. petiolaris* €, *sericea* Andersson apud de Candolle, Prodr. xvi.<sup>2</sup> 235 (1868.)

This species was described in 1785 by Marshall in a short but sufficient manner. The type probably came from Chester County, Pennsylvania.



In 1803, Muhlenberg gave a more detailed description adopting Marshall's name. Willdenow in 1805 changed the name to *S. grisea*, and retained *S. sericea* of Villars (1789), which represents a European form very closely related to *S. glauca* Linnaeus. Pursh (1814) kept Willdenow's name, but he also has a *S. rosmarinifolia* which has nothing to do with Willdenow's plant whom he quotes as author. It is, in my opinion, a form of *S. sericea*, growing "in wet meadows and mountain swamps: Pennsylvania to Carolina."

A rather obscure Willow which may belong to *S. sericea* is *S. argentea* of Dumont de Courset (1811) which is said to be a North American plant, and of which the author gives the following account: "Arbrisseau de 2 à 3 pieds; les branches et les rameaux bruns, courts et fermes. Feuilles ovales-lanceolées, soyeuses et argentées des deux côtés, plus grandes que celles des espèces précédentes [*incubacea*, *fusca*, *rosmarinifolia*]. Lieu. L'Amerique sept. Cette espèce ne me paroît être qu'une variété de la 19 [*lanata*] ou de la 20 [*lappinum*]."

Forbes (1829) does not mention *S. grisea*, and the plant he figures as *S. sericea* apparently is a form very similar to Villars' species. He, however, has a *S. pennsylvanica* which probably is nothing but *S. sericea*. This was also the opinion of Borrer, as quoted by Loudon (1838) under *S. grisea*. Barratt also used this name in 1840, and he, too, cites Forbes' species as a synonym. Carey (1848) took up Marshall's name which has been accepted by all later botanists.

Torrey (1843) made *S. sericea* a variety of *S. petiolaris* under the name var. *grisea*. Andersson (1858) used probably by mistake the name *S. grisea* and quoted Marshall as the author and Gray's Manual. In Sal. Bor.-Am. Gray corrected this mistake. In 1867, Andersson made *S. sericea* a kind of subspecies of *S. petiolaris* and expressed himself as follows in regard to its relationship: "Est forma sat singularis e nostratibus *S. viminali* et *S. fragili* subsimilis, ex americanis *S. petiolaris* maxime affinis." In 1868 he changed the subspecies to a variety of *S. petiolaris*.

*S. sericea* is certainly closely related to *S. petiolaris* but it is not difficult to separate the two species, as already stated by Griggs (1905). The closest relationship with *S. sericea* is found in *S. coactilis* which, however, so far as I can judge by the material before me, differs in the coarser teeth of its leaves, the somewhat larger fruits and in the glabrous pedicel. See also my remarks under this species and under *S. petiolaris*.

I have seen material of *S. sericea* from the following states: New Brunswick; Maine (Aroostook County); Vermont (Caledonia and Lamoille Counties); Massachusetts (widely spread); New York (frequent); Pennsylvania (Chester, Bidford and York Counties); Connecticut, Rhode Island, New Jersey, Maryland, District of Columbia, northern Virginia, West Virginia (Randolph and Pocahontas Counties); North Carolina (Polk, Macon, Mitchell, Orange and Durham Counties); South Carolina (Ocanee County); Kentucky (near Louisville); Ohio (according to Schaffner "general"); Indiana (Randolph, Hancock, Floyd, Grant, Jackson, Hamilton, Lagrange, Knox and

Davies Counties); Illinois (little material seen); Missouri (St. Louis, Cape Girardeau, Iron and Wayne Counties); Iowa (eastern part); Michigan (neighborhood Flint County).

2. *S. coactilis* Fernald in *Rhodora*, viii. 21 (1906). — This species has been well described by Fernald, and is as yet only known from Penobscot County in central Maine. I cannot add anything of value to Fernald's statements except that according to my observations the pedicel is only twice (not about five times) as long as the gland as is also the case in typical *S. sericea*. Fernald says that "the shrub of central Maine is in the shape of its capsule and its distinct style as closely related to the arctic-alpine *Salix argyrocarpa* Anders. as to *S. sericea*." Unfortunately the male plant of *S. coactilis* is still unknown; it would be of great interest to ascertain whether the flowers have one gland as in *S. sericea* or two as in *S. argyrocarpa*. After all it seems to me much more closely related to *S. sericea* than to the latter species.

3. *S. petiolaris* Smith in *Trans. Linn. Soc. Lond.* vi. 122 (1802); *Engl. Bot.* xvi. t. 1147 (1803); *Fl. Brit.* iii. 1048 (1804); *Engl. Fl.* iv. 181 (1828). — Willdenow, *Spec.* iv. 665 (1805). — Pursh, *Fl. Am.* Sept. ii. 616 (1814). — Poiret in Lamarck, *Enc. Suppl.* vi. 57 (1817). — Forbes, *Salict. Wob.* 45, t. 23 (1829). — Hooker, *Brit. Fl.* ed. 3, i. 423 (1835). — Loudon, *Arb. Brit.* iii. 1533 (1838). — Carey apud Gray, *Man.* 483 (1843). — Andersson in *Öfv. Svensk. Vet.-Akad. Förh.* xv. 126 (1858); in *Svensk. Vet.-Akad. Handl.* vi. 108 (*Monog. Salic.*) (1867), excl. var. pro parte; in De Candolle, *Prodr.* xvi.<sup>2</sup> 234 (1868), excl. var. pro parte. — Macoun, *Cat. Can. Pl.* iii. 453 (1886) pro parte. — Britton & Brown, *Ill. Fl.* i. 500 fig. 1189 (1896); ed. 2, i. 599, fig. 1470 (1913). — Britton, *Man.* 318 (1901). — Schneider, *Ill. Handb. Laubh.* i. 64, fig. 19 c, 20 t-t' (1904). — Robinson & Fernald, *Gray's Man.* ed. 7, 326 fig. 662 (1908). — *S. grisea*  $\beta$  *subglabrata* Koch, *De Salic. Comm.* 21 (1828). — *S. petiolaris* l. *rigida* f. *longifolia* Andersson in *Svensk. Vet.-Akad. Handl.* vi. 109 (1867); in De Candolle, *Prodr.* xvi.<sup>2</sup> 234 (1868). — *S. petiolaris*  $\beta$  *rigida* 3 *brevifolia* Andersson, l. c. 234 (1868).

This species was described in 1802 by the well-known English salicologist J. E. Smith who published a good picture of it in 1803. At first he said "this species has not been found wild in Norfolk, but was sent to Mr. Crowe by Mr. Dickson along with the last, as of British growth," while in 1803 he states: "for this new species of *Salix* we are obliged to Mr. Dickson who found it in some part of Great Britain, the exact place is not remembered, and sent it in a growing state to Mr. Crowe. We only know the female which is a small spreading tree." Pursh (1814) declared that "it has been by mistake adopted as a native of Great Britain." Smith however in 1829 thought it possible that it might grow in Europe, and that the statements that it had been found in Scotland "are not likely to be erroneous." Hooker mentions the species in 1835 but says, "I have never seen native specimens." Loudon who in 1838 quotes these different opinions says: "Mr. Borrer had formerly both sexes growing at Henfield having received the male from Mr.



G. Anderson." How this plant came to England has never been exactly explained. It is not mentioned in later books on the English flora.

Koch (1828) made *S. petiolaris* a var.  $\beta$  *subglabrata* of *S. grisea* using *grisea* for *S. sericea*. Andersson (1858) mentioned it only briefly, while in 1867 he distinguished the varieties *rigida* and *subsericea*. The last is now generally regarded as a hybrid between *S. petiolaris* and *S. sericea*. Of the first Andersson described two forms: f. *latifolia* and f. *longifolia* but he does not cite any specimens. His diagnosis of f. *latifolia* runs: "foliis 2-3 poll. longis, basi latiori subrotundatis, infra medium  $\frac{3}{4}$ -1 poll. latis, subito cuspidatis, argute serratis, rigidissimis, subtus valde intense glaucis. Haec forma non raro modificationibus *S. lucidae* aut *S. discoloris* similis est ob folia basi sat lata et subito acuminata, rigida et sublucida; sed facile distinguitur amentis longe alienis." I have not seen a specimen really agreeing with this description, to which Andersson in 1868 adds that the leaves are "aut valde intense glaucis aut pure et lucide viridibus." He probably confused different plants. Andersson's f. *longifolia* is nothing but the typical *S. petiolaris*, and he himself says in 1868 "haec fere typica." In 1867, his variety consists of forms with leaves lustrous silky beneath "ut *S. discolor*," and others with glabrous leaves. In the Prodomus he adds a f. *brevifolia* with shorter leaves (1-2 inches long, instead of 3-4 inches as in f. *longifolia*) which are hardly  $\frac{1}{2}$  inch wide. I do not think this is a form of any taxonomic value.

In 1858 Andersson described a *S. gracilis*, from specimens collected by Drummond and Richardson in Saskatchewan to which he cites as a synonym *S. rosmarinifolia* Hooker (1839). The type of this willow is Richardson's specimen from Cumberland House (Hooker says only Saskatchewan). There is a co-type of it in Herb. Barratt. Andersson also named Richardson's no. 387 (Herb. K.) *S. gracilis* which is called by Richardson *S. purpurea*. Hooker, too, cites *S. purpurea* from "Cumberland House Fort, Dr. Richardson." Besides this Andersson himself named *S. gracilis* a species of Drummond's from Saskatchewan in Herb. K. All these specimens agree well with each other. From typical *S. petiolaris* they chiefly differ in their more linear leaves (according to Andersson "latitudine fere decies longioribus") and in their longer pedicels (about 4 mm. long instead of 3 mm.); the whole aspect of the plant therefore is a little different. In 1858, Andersson speaks of *S. gracilis* as "quasi hybridae *S. vagante* [*S. Bebbiana*] et *S. myrtilloide* [*S. pedicellaris*]," while in 1867, regarding *S. gracilis* as a kind of subspecies of *S. petiolaris* he more correctly remarks: "Habitu a *S. petiolaris* majori et typica valde recedit sed modificationibus permultis cum ea intime connexa est. Indumentum foliorum idem, ut etiam capsularum, sed forma in hac angustior magisque elongata. Ramis in forma arbusculae humilis erectis, foliis angustis et amentis primum subglobosis habitum *S. rosmarinifoliae* nostrae prae se fert, sed ab ea luculenter differt capsulis longissime pedicellatis."

Andersson, in 1858, also made a var. *rosmarinoides* of *S. gracilis* which differs only in its "foliis apicem versus serrulatis in *gracilis* integerrimis marginibus acutiusculis, subrevolutis." This sentence apparently should

run: foliis acutiusculis . . . margine subrevolutis. The type of it came from "Durham County." To this statement Gray (Sal. Bor.-Am. p. 22) has added "New Jersey." So far as I know there are two counties of this name in North America, one in Ontario, the other in North Carolina. In New Jersey there is only a village named Durham, Andersson's form probably came from Ontario, certainly not from North Carolina. He says of it: "Varietas, ut etiam nostra, *S. gracilis* ' *S. rosmarinifolia* Barratt ' inscripta, multo magis ad *S. rosmarinifoliam* veram accedit. Obstant autem capsulae longissime pedicellatae." Of this form I have had a fragment before me, and on the photograph of the type of *S. gracilis* there can be seen part of the type of var. *rosmarinoides*. I cannot distinguish it from typical *gracilis* which has entire or more or less serrate leaves. In 1867 Andersson does not even mention var. *rosmarinoides* or the specimen from Durham County. He refers to *S. gracilis* a specimen from "ad Milwaukee (Lap-ham)," and this fact proves that he also referred to his *gracilis* specimens of a more southern origin.

In 1868 Andersson somewhat changed his opinion by describing besides var. *gracilis* a var. *angustifolia* without mentioning var. *rosmarinoides*. The type of var. *angustifolia* is "*S. rosmarinifolia* Barratt (Hb. Hook.) et Hook. Fl. Boreal.-amer. 2. p. 148 pp." It is characterized by "foliis anguste lanceolatis fere linearibus margine tenuiter serrulatis v. subintegris" and he says of it: "Haec quae regiones magis septentrionales praecipue incolit, nostrae *S. rosmarinifoliae* sat similis, sed differt foliis subserratis, capsulis longius pedicellatis et habitu! Ad sequentem transitum evidentissimum effecit et ab ea difficillime distinguenda; e contrario in formas minus latifolias et rigidas *S. petiolaris* sensim confluit." The "following" variety is var. *gracilis* which, indeed, can be distinguished only "difficillime" or better not at all from var. *angustifolia*. This last form certainly is identical with var. *rosmarinoides* of 1858, and this is another instance of Andersson's changing of names without even quoting again his former denominations. Now, if we take *gracilis* for a variety of *S. petiolaris* we must use the name *rosmarinoides* for it. Barratt, to be sure, had already made a *S. petiolaris* var.  $\beta$  *angustata* in 1840 (Sal. Am. sub no. 9), and he says of the typical *petiolaris* "there are several varieties of it; some with narrower leaves," but he had in mind only forms of Pennsylvania and New York. Therefore, this var. *angustata* refers to narrow leaved forms of the type which have longer fruiting aments with more crowded fruits with pedicels up to 3 mm. in length. Such forms have been distributed by Bebb in his Herb. Salic. under nos. 28 and 29; they seem to unite the type with var. *rosmarinoides*. Of this variety the type shows a few stomata in the upper epidermis of the leaves, something which I have not observed in other specimens.

In the forms of typical var. *rosmarinoides* the under surface of the leaves is always glabrous or almost so (with exception perhaps of the very youngest leaves) while the upper surface is more or less hairy. There occurs, however, in Maine and Quebec a form of which the young leaves (at least partly)



bear a rather conspicuous pubescence of silvery or fuscous silky hairs on their lower surface. The mature leaves of this form seem to become glabrous (at least partly) like those of var. *rosmarinoides*, and I doubt whether it can be kept as a separate variety under any name but var. *rosmarinoides*. It is the same form which is called *S. petiolaris* var. *angustifolia* by Fernald & Wiegand (in *Rhodora* xii. 137 [1910]).

Andersson, in 1868, distinguished two forms of var. *gracilis*: 1° *sericocarpa*, capsulis anguste conicis  $2\frac{1}{2}$  lin. longis tenuiter sericeis, and 2° *lejocarpa*, capsulis basi crassioribus glaberrimis viridi-testaceis. He does not cite any specimen, and I have not yet seen a specimen with entirely glabrous fruits. These are often, as Andersson in 1867 states in regard to *gracilis*, only "parcissime pubescentibus," but the pedicel always is minutely pubescent. Therefore I cannot say whether there is a real f. *lejocarpa* or not.

The synonymy of var. *rosmarinoides* and its taxonomic characters are as follows:

*S. petiolaris* var. *rosmarinoides*, comb. nov. — *S. purpurea* Richardson apud Franklin, Narr. Jour. Polar Sea, 752 (Bot. App. vii. 24, no. 387) (1833), fide specimen originale, non Linnaeus. — Hooker, Fl. Bor.-Am. ii. 148 (1839). — *S. rosmarinifolia* Hooker, l. c., non Linnaeus. — *S. gracilis* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 127 (1858). — Rydberg, Fl. Rocky Mts. 195 (1917). — *S. petiolaris* \* *rosmarinoides* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 127 (1858). — *S. petiolaris* \* *S. gracilis* Andersson in Svensk. Vet.-Akad. Handl. vi. 109 (Monog. Salic.) (1867). — *S. petiolaris* γ *angustifolia* Andersson in De Candolle, Prodr. xvi.<sup>2</sup> 234 (1868), pro parte. — Fernald & Wiegand in *Rhodora*, xii. 137 (1910). — *S. petiolaris* δ *gracilis* Andersson in De Candolle, l. c. 235 (1868), excl. prob. f. *lejocarpa*. — Macoun, Cat. Can. Pl. iii. 453 (1886). — *S. petiolaris* Rydberg, Fl. Rocky Mts. 195 (1917), pro parte minima. — A typo praecipue differt: foliis angustioribus, plusminusve lineari-lanceolatis vel linearibus, saepe subacuminatis, basi acutioribus, integerrimis vel plerisque tantum partim (saltem ad apicem) minute denticulatis, saepissime 3: 0.5 ad 6: 0.7–0.8 cm., in ramulis vegetioribus ad 7.5: 1–1.3 cm. magnis, subtus initio satis fulvo-sericeis, demum glabris glaucis vel in forma sericeo-pilosa utrinque plusminusve sericeis (pilis argenteis saepe cum fulvis mixtis); amentis fructiferis subbrevioribus, crassioribus et minus laxifloris, vix ultra 3: 1.8–2 cm. magnis, fructibus 7–9 mm. longis, pedicello 3–4 mm. longo excluso.

Of typical *S. petiolaris* I have seen specimens from the following states: New Brunswick (St. Stephen), Massachusetts, New York, New Jersey, Pennsylvania, Ohio, Indiana, Michigan, Minnesota, Ontario, Manitoba (West Selkirk, Lake Winnipeg), and Saskatchewan (Cumberland House).

To var. *rosmarinoides* I refer specimens from Alberta, Saskatchewan, Ontario, Quebec and Maine. Some forms from Maine need further observation. There is also a specimen from British Columbia (Cache Creek May 23, 1875, J. Macoun, no. 24,700, O.; f.) which I am not able to determine at present.

4. *S. humilis* Marshall, Arbust. Am. 140 (1785); Cat. Arb. Arbriss. 223 (1788). — Carey apud Gray, Man. 425 (1848). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858); in Svensk. Vet.-Akad. Handl. vi. 110 t. vi. fig. 62 (Monog. Salic.) (1867), excl. var. pro parte et sub-spec. *Hartwegii*; in De Candolle, Prodr. xvi.<sup>2</sup> 235 (1868), excl. form. pro parte et var. *Hartwegii*. — Bebb apud Watson & Coulter, Gray's Man. ed. 6, 483 (1890). — Ball in Proc. Iowa Acad. Sci. vii. 148, t. 11, fig. 7 (1900); in Elys. Marian. iii. 35, t. 7, fig. c (1910). — Britton & Brown, Ill. Fl. i. 498, fig. 1185 (1896); ed. 2, i. 600, fig. 1473 (1913). — Britton, Man. 317 (1901). — Robinson & Fernald, Gray's Man. ed. 7, 326, fig. 660 (1908), excl. var. — *S. confifera* Wangenheim, Beytr. Forstw. Nordam. Holzart. 123, t. 31, fig. 72 (1787), pro parte; Willdenow, Spec. Pl. iv. 705 (1805) pro parte; Berlin. Baumzucht, ed. 2, 455 (1811) pro parte. — Muhlenberg in Neue Schr. Ges. Nat. Freunde Berlin, iv. 240 (1803). — Elliott, Sketch Bot. ii. 669 (1824). — Pursh, Fl. Am. Sept. ii. 612 (1814), pro parte. — ? *Salix* spec. Schoepf, Mat. Med. Am. 147 (1787). — ? *S. flava* Gmelin, Syst. Nat. (Linn. ed. 13) ii. 74 (1791). — *S. occidentalis* Walter, Fl. Carol. 243 (1788). — *S. tristis* Muhlenberg in Neue Schr. i. c. 241 (1803), pro parte et quoad t. vi. fig. 9, non Aiton. — *S. Mühlenbergiana* Willdenow, Sp. Pl. iv. 693 (1805), pro parte minima. — *S. Mühlenbergiana* Pursh, Fl. Am. Sept. ii. 609 (1814), excl. synonym. ex parte. — Elliott, Sketch Bot. ii. 667 (1824) excl. syn. Walter. — Forbes, Salict. Wob. 278 (1829), an excl. fig. 145?. — Torrey, Fl. N.Y. ii. 205 (1843). — Barratt, Sal. Am. no. 1 (1840), prob. excl. var. pro parte. — *S. humilis longifolia* Andersson in Svensk. Vet.-Akad. Handl. vi. 111 (1867), excl. formis pro parte; in De Candolle, Prodr. xvi.<sup>2</sup> 236 (1868), excl. formis pro parte. — *S. humilis angustifolia* Andersson in Svensk. l. c. (1867) excl. formis; in De Candolle, l. c. (1868), excl. formis. — ? *S. tristis glabrata* Andersson in Svensk. l. c. 113 (1868); in De Candolle, l. c. 237 (1868).

This species was described by Marshall as follows: "This seldom rises above three or four feet, with greenish, somewhat downy stalks. The leaves are larger than the other kinds [*nigra*, *sericea*] entire, oblong, somewhat oval, and glaucous or whitish underneath. There are some varieties of larger growth, belonging either to this or the last mentioned kind" [*sericea*]. There is no doubt that this description can only be applied to what we now call *S. humilis*. Two years later Wangenheim published his *S. confifera* restricted to *S. discolor* by Willdenow in 1796. Wangenheim's figure, as I explained already under *S. discolor*, is very inaccurately drawn, and his diagnosis partly fits *S. discolor* (12 to 15 feet high), partly *S. humilis* (foliis ovato-lanceolatis acutis . . . subtus tomentosis), as also does his remark "sie haben kurze Blattstiele." He speaks of 2 to 7 stamens which must be an erroneous statement. So far as I can judge by his description he had before him either *S. discolor* var. *latifolia* (see p. 4) or *S. humilis*. Without having seen a type (for instance the specimen from which the figure was drawn) I cannot decide what Wangenheim really had in mind. I believe, however, he mixed the two forms just mentioned. Willdenow's description of 1796 in my opinion, applies to *S. discolor*. Later, in 1805 and 1811, Willdenow added



*S. longirostris* Michaux as a synonym to his *conifera*, but Michaux's species is *S. tristis*.

In 1787, Schoepf mentions a *Salix* spec. which has been named by Gmelin (1791) *S. flava*. This plant may be identical with *S. humilis*, but I am not able to decide which Willow Schoepf meant in speaking of "foliis . . . tenuissime serratis." This sentence has been omitted by Gmelin. Walter, in 1788, proposed a *S. occidentalis* with "foliis integris subtus tomentosis." This is apparently nothing but *S. humilis* because he also describes *S. tristis* as *S. alpina*. Muhlenberg (and Willdenow) in 1803, has besides *S. tristis* a *S. conifera* which according to Willdenow is the same as his *conifera* of 1796 and that of Wangenheim. Muhlenberg's diagnosis, however, fits *S. humilis* best; and he also proposed at the same time *S. discolor* as a new species. The fig. 9 on Muhlenberg's t. vi. which he refers to *S. tristis* probably belongs to his *S. conifera* (= *S. humilis*). Possibly part of Muhlenberg's *S. tristis* really applies to *S. humilis*, because he speaks of "caule pedali-quadripedali," and says of it "an satis distincta a *Conifera*."

Willdenow, in 1805, suspected that Muhlenberg's *S. tristis* was not the true *tristis* of Aiton, and he proposed for it the name *S. Mühlenbergiana*, referring to it also *S. incana* Michaux as a synonym. This last species, however, is *S. candida* Fluegge. I think that *S. tristis* Muhlenberg for the most part represents the true *tristis*, and only pro parte minima is to be referred to *S. humilis*. Pursh's *S. Mühlenbergiana* is the same as *S. humilis* except the synonyms *S. alpina* Walter and *S. tristis* Muhlenberg, pro parte. Pursh also has a *S. recurvata* which commonly (see Barratt, Andersson, Ball and others) is regarded as a (at least doubtful) form of *S. humilis*. Pursh says "S. foliis obovata-lanceolatis acutis integerrimis margine glandulosis glabris subtus glaucis, junioribus sericeis, stipulis nullis, amentis praecocibus recurvatis, squamis apice nigris, pilis longitudine germinis, germinibus ovatis, brevi-pedicellatis sericeis, stylo brevissimo, stigmatibus bifidis." "In shady woods in the mountains of New Jersey and Pennsylvania." "A low shrub; branches brown, smooth; buds yellow." I hesitate to identify it with *S. humilis*. On the other hand, Pursh's *S. fuscata* (Fl. Am. Sept. 612 [1814]) might be connected with *S. humilis*, Barratt (1840 under no. 12) has a Willow named *S. fuscata* which "grows in pools and swamps and on wet banks. It furnishes excellent twigs suitable for fine basket work. . . ." He puts it in his section *Griseae*; and Torrey in 1843 (Fl. N.Y. II. 207) in describing *S. petiolaris sericea* says: "I suspect that *S. fuscata* Pursh must be united with "*S. grisea* and *S. sericea*." Pursh however lays stress upon the "dark brown or black tomentum" which covers the branches of the preceding year, and the fact that the young leaves are pubescent and the old ones obovate-lanceolate and I suspect that it may have a closer relationship with *S. humilis* than with *S. sericea* or *S. petiolaris*, of which it has been made a synonym by Andersson (1867).

Barratt (1840) discusses *S. Mühlenbergiana* at considerable length, and uses that name for *S. conifera* Muhlenberg (not as Willdenow did for *S. tristis* Muhlenberg). Muhlenberg's *S. conifera*, as already explained, is *S.*

*humilis*. Barratt<sup>1</sup> asserted that Willdenow mixed different species, and he too stated, that *S. Mühlenbergiana* Forbes (1829) "is *S. tristis* Aiton." Forbes just copies Pursh's description, and the leaf represented in his fig. 145 may be taken for a small one of *S. humilis* or a large one of *S. tristis*.

Barratt's varieties of *S. Mühlenbergiana* are nomina nuda. They cannot be determined without type specimens. Torrey (1843) also used the name *Mühlenbergiana*, and it was Carey who in 1848 reestablished Marshall's name *S. humilis*. He cites, in the synonymy, *S. Mühlenbergiana* Barratt and *S. conifera* Muhlenberg. Andersson's (1858) followed Carey in keeping the oldest name. In his monograph (1867) he proposed three varieties each comprising two forms. He held the same view in the Prodrum (1868). The first variety is var. *grandifolia* to which he cites *S. conifera* Muhlenberg as a synonym. It is said to be characterized by: "foliis obovato-oblongis, 3-4 poll. longis supra medium plusquam  $1\frac{1}{2}$  poll. latis, supra nitidis, subtus intense glaucis saepius demum glabratiss." Of this variety he distinguishes f. *obtusata* (in 1868 f. *obtusifolia*) with "foliis apice subrotundato oblongo-obovatis, subtus non raro dense albo-tomentosis" while in 1868 he says "foliis . . . subtus aut denudatis glaucescentibus aut tenuiter albo-tomentosis." Besides this there is a f. *acuminata* (1867 and 1868) with "foliis apice productiori breve acuminatis, tenuioribus, subtus tomento evanido glabratiss, glaucescentibus." He adds, in 1868, "*S. prinoidi* subsimilis, sed differt foliis tenuibus amentis brevibus, capsulis brevius pedicellatis." After all, Andersson's var. *grandifolia* seems to be no true *S. humilis* but a rather uncertain form of possibly hybrid origin.

Of his var. *longifolia* (1867 and 1868) Andersson states himself: "haec forma est typica." He proposes three forms of it: the first f. *rigidiuscula* is (1867) said to be "*S. discolori* quoad folia subsimilis," while in 1868 he says: "ad *S. triste* appropinquans." The leaves are described as "supra opacis sed glabris, subtus intense tomentosis." Generally the leaves of *S. humilis* are also pubescent on the upper side, at least on the midrib. Robinson & Fernald (Gray's Man. ed. 7, 326) use the name *rigidiuscula* for forms with leaves which are "very rugose and glabrescent beneath. (O. to Ga. and Kan. — Shrub or small tree)." It is more than doubtful to me whether this last form is the same as Andersson's f. *rigidiuscula*. I have not been able to get a good idea of the forms to which Robinson & Fernald refer.

Andersson's second form of var. *longifolia* is f. *glauca* with "foliis acuminato-cuspidatis, supra nitide viridibus, subtus intense glaucis denudatis." In 1867, Andersson adds: "Formis angustifoliis *S. lucidae* haud absimilis," a sentence omitted in 1868. I have not seen a form to which this description would fit. The third form is f. *tenuis* "foliis tenuibus subpellucidis et ideo rufescentibus, subtus vix tomentosis opacis." Here, too, Andersson does not cite a specimen or a locality. The description points to a typical form with young leaves.

<sup>1</sup> He too considers *S. villosa* Forbes, Salic. Wob. 183, t. 92 (1829) as the same as *S. tristis* Aiton. Forbes, however, says that the leaves are "covered with small shining hairs" beneath, and he gives no clue to its origin. The flowers are wanting, and after all it is a very uncertain species.



The third variety is var. *angustifolia* with "foliis 1-2 poll. longis vix  $\frac{1}{4}$  poll. latoribus, supra opaco-cinerascentibus subtus pallidis tomentosis nec denudatis," while in 1868 the sentence runs "foliis 1-2 poll. longis vix  $\frac{1}{2}$  poll. latis subtus glaucescentibus vel tenuiter tomentosis." In 1868 he puts under this variety f. "*recurvata* (Psh): capsulis recurvatis," and f. "*opaca*: capsulis brevissime vel vix pedicellatis (Wright, Coll. Nov. Mexic. n. 1878)." In 1868 he says: "Huc forsan etiam pertinent: *S. recurvata* Pursh . . . et forma *opaca* . . ." Of *S. recurvata* Pursh I have already spoken. Wright's no. 1878 is a form with glabrous (not only glabrescent) capsules which does not belong to *S. humilis* at all.

*S. Hartwegii* Bentham which is regarded by Andersson as a subspecies (1867) or doubtfully as a variety (1863) of *S. humilis* has nothing whatever to do with this species. See my note in Bot. Gaz. LXV. 28 (1918).

To *S. humilis* seems to belong also Andersson's *S. tristis glabra* (1867 and 1868) of which he himself says: "Ad *S. humilem* aperte accedens." I have not seen a type. It is extremely difficult to distinguish well marked varieties of *S. humilis* until full series of the variations of the different regions and localities have been collected. The first question that arises is: can *S. tristis* be regarded as a good species, or only as a variety of *S. humilis*, as asserted by Griggs (see later under *S. tristis*). Almost all authors agree that *S. tristis* is, as Ball (1910) says, "very similar to *S. humilis* but smaller in every way." It differs from *humilis* chiefly in its thinner branches, shorter petioles (hardly more than 3 mm. long), smaller leaves (scarcely up to 5 cm. long and 1-1.3 cm. wide), the absence of stipules, present and linear only on vigorous shoots and in its smaller aments. Probably it is nothing but an ecological subspecies.

I am not able to discuss certain forms of *S. humilis* from the northeast which partly resembles *S. discolor*. There are others, too, in the middle west that need careful observation in the field. I have seen material of *S. humilis* sensu lato from the following states and counties: Vermont (Caledonia County), Massachusetts (Middlesex, Hampshire, Essex and Suffolk Counties), Connecticut (Fairfield County), New York (Tompkins, Warren, Wayne Counties and Long Island), Rhode Island (Providence County), New Jersey (Bergen and Ocean Counties), Maryland (Montgomery County), District of Columbia, Virginia (Bedford County), North Carolina (Buncombe County), West Virginia (Randolph County), Georgia (Sumter County, uncertain form), Florida (Leon County), Pennsylvania (Chester and York Counties), Kentucky (Jefferson County), Mississippi (Alcorn County) Arkansas (Polk and Clay Counties), Texas (Pottawatomie and Atchinson Counties), Nebraska (Nuckolls, Cass, Howard, Thomas, Holt and Brown Counties), Iowa (Lyon, Cerro Gordo, Floyd, Humboldt, Delaware, Story, Decatur and Poweshiek Counties), Missouri (St. Louis, Pike, Wayne, Howell, Carter, Newton, Jasper, Scott, Webster, Shannon, Jepson, Macon, Putnam and Clark Counties), North Dakota (Richland County), Minnesota (Ramsay County), Wisconsin (Sauk County), Michigan (Ingham, Wayne and St. Claire Counties), Ohio (Franklin and Scioto Counties), Illinois (St,

Claire, Richland, Clinton, Cook and Mason Counties), Indiana (Clay, St. Joseph, Lagrange, Allen, Winnebago, Steuben and Crawford Counties), Ontario (Essex District).

5. *S. tristis* Aiton, Hort. Kew. iii. 393 (1789). — Muhlenberg in Neue Schr. Ges. Nat. Fr. Berlin, iv. 241 (1803) excl. t. vi. fig. 9. — Willdenow, Spec. Pl. iv. 693 (1805). — Dumont de Courset, Bot. Cult. ed. 2, vi. 396 (1811). — Pursh, Fl. Am. Sept. ii. 609 (1814). — Elliott, Sketch Bot. ii. 668 (1824). — Forbes, Salict. Wob. 279 (1829), prob. excl. fig. 150. — Barratt, Sal. Am. no. 2 (1840). — Torrey, Fl. N.Y. 205, t. 118 (1843). — Carey apud Gray, Man. 425 (1847). — Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858); in Svensk. Vet.-Akad. Handl. vi. 112, t. vi. fig. 63 (Monog. Salic.) (1867), excl. var.; in De Candolle, Prodr. xvi.<sup>2</sup> 236 (1868), excl. var. — Macoun, Cat. Can. Pl. iii. 455 (1886). — Ball in Proc. Iowa Acad. Sci. vii. 149 (1900); in Elys. Marian. iii. 35, t. 9, fig. a (1910). — Britton & Prown, Ill. Fl. 1. 499, fig. 1186 (1896); ed. 2, i. 600, fig. 1474 (1913). — Schneider, Ill. Handb. Laubh. i. 64, fig. 11 x-y, 12 u (1904). — Robinson & Fernald, Gray's Man. ed. 7, 326, fig. 661 (1908). — *S. alpina* Walter, Fl. Carol. 243 (1788), non Scopoli (1772). — Blake in Rhodora, xiii. 136 (1915). — *S. longirostris* Michaux, Fl. Bor.-Am. ii. 226 (1803). — Bigelow, Fl. Bost. ed. 3, 391 (1840). — *S. Mühlenbergiana* Willdenow, Spec. Pl. iv. 692 (1805), pro parte et excl. syn. *S. incana* Michaux. — *S. Mühlenbergiana* Pursh, Fl. Am. Sept. ii. 609 (1814), pro parte. — Elliott, Sketch Bot. ii. 667 (1824), pro parte. — *S. conifera* Willdenow, Spec. Pl. iv. 705 (1805) et Berlin. Baumzucht, ed. 2, 455 (1811) pro parte, quoad syn. *S. longirostris*, non Wangenheim. — Pursh, Fl. Am. Sept. ii. 609 (1814), pro parte, quoad syn. *S. longirostris*. — Elliott, Sketch Bot. ii. 669 (1824), pro parte, quoad syn. *S. longirostris*. — *S. tristis* var.  $\beta$  *monadelphia* Barratt, Sal. Am. no. 2 (1840). — *S. tristis microphylla* Andersson in Öfv. Svensk. Vet.-Akad. Förh. xv. 126 (1858). — ? *S. tristis longiflora* Andersson in Svensk. Vet.-Akad. Handl. vi. 113 (1867). — *S. humilis* var. *tristis* Griggs in Proc. Ohio Acad. Sci., iv. 301, t. x, partim (1905).

Walter (1788) was the first to describe this species as *S. alpina* but this name had been used before by Scopoli for a European Willow.<sup>1</sup> Aiton's original diagnosis is: "S. exstipulacea, foliis lineari-lanceolatis petiolatis rugosis subtus tomentosis. Nat. of Pennsylvania. Mr. William Young. Introd. 1765." The type therefore of *tristis* came from Pennsylvania. Muhlenberg (1803) gave a rather good description of it but the leaf which he figured looks more like one of *S. humilis* than of *S. tristis*. As I have already explained he probably had *S. humilis* partly in mind, and I have also referred under *S. humilis* to Willdenow's treatment of *S. tristis*. Michaux's *S. longirostris* is probably *S. tristis* because he says "foliis subsessilibus longiuscule lanceolatis" Forbes (1829) describes the true *S. tristis* but the

<sup>1</sup> Scopoli's *S. alpina* is a rather uncertain form. It has been referred with a query to *S. arbuscula* Linnaeus by A. & E. G. Camus, Class. Saules d'Europe, i. 124 (1904), while v. Seemen in Ascherson & Graebener, Syn. Mitteleur. Fl. iv. 164 (1908) partly refers it to *S. myrsinites* var. *Jacquiniana* Koch.



leaf represented by him in his fig. 150 is finely glandular-serrate. Barratt mentions a forma *monstrosa* with partly united filaments which he calls var. *monadelphica* of which I have seen the type. Torrey (1843) gives a good description and figure of typical *S. tristis* under the correct name. Andersson (1858) cites Gray's manual, and has a var. *microphylla* which is nothing but the type. In 1867 he does not mention this variety, but he has three other forms: *glabrata*, *minor* and *longiflora*. The first seems to belong to *S. humilis*; the second which he called *nivea* in 1868, I take to be *S. candida*, while the third is probably typical *S. tristis*.

As I have already pointed out under *S. humilis* it is doubtful if *S. tristis* can be kept as a distinct species or considered a variety of *S. humilis*. Griggs who holds the latter view makes the following statement: "A depauperate form of *S. humilis* with which it is connected by many intermediates. It may be described as smaller and hairier throughout. It is quite low (to 6 dm.) with smaller leaves (to 5 cm. long) more strongly gray tomentose, and catkins sometimes scarcely 5 mm. long. This can hardly be regarded as a distinct species. There is not a single constant character by which the two differ and what differences there are, are such as would be likely to be caused by differences in environment. Such forms should be considered as varieties rather than as species."

I have seen specimens of *S. tristis* from the following states and Counties: Massachusetts (Middlesex, Hampshire, Norfolk, Essex, Worcester, Plymouth, Bristol and Barnstable Counties), Rhode Island, Connecticut (New London and Middlesex Counties), New Jersey (Gloucester, Cumberland, Camden, Middlesex and Salem Counties), New York (Suffolk, Queens, Nassau and King's Counties), Delaware (New Castle County), Pennsylvania (Chester, Lancaster and Luzerne Counties), Virginia (Fairfax County), District of Columbia, North Carolina (Rowan and Macon Counties), Kentucky (Webster and Edmonson Counties), Tennessee (Robertson and Coffee Counties), Florida (Leon County), Indiana (Vermilion, Cass and White Counties), Illinois (Winnebago and Hancock Counties), Wisconsin (Sauk County), Missouri (St. Louis, Phelps, Jasper and Atchison Counties), Nebraska (Brown and Custer Counties), Mississippi (Kemper County; an *humilis*?), Iowa (Hamilton, Boone, Harrison, Johnson, Floyd and Story Counties).

VIENNA, April, 1920.

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## A PHYTOGEOGRAPHICAL SKETCH OF THE LIGNEOUS FLORA OF FORMOSA

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THE island of Formosa is off the east coast of China and is situated between 21° 45' N. latitude and between 119° 18' and 122° 6' E. longitude. It is oblong in shape and about 244 miles long and in the widest part is 75.6 miles broad; at the extreme south its breadth is only 7.3 miles while in the extreme

north it is 12.2 miles broad. The circumference of the island is about 708 miles, and the total area is about 13,908 square miles, being about the same size as Kyushu, the southern island of Japan. Formosa is very mountainous, with a central axis stretching from north to south and situated well toward the east side. The central range is composed of palaeozoic rocks, chiefly clay slates and its average height is about 3000 m. Several peaks are over 3600 m. and the highest, Mt. Morrison, situated on the Tropic of Cancer, is 3985 m. high. The north is largely volcanic while the extreme south is of coral formation. The east coast is for the most part bold, rugged, and without safe anchorage. From Pinan to Karenko stretches a coastal range, largely volcanic, and not more than 1200 m. high. Between this coastal range and, the foothills of the main axis is a narrow valley which constitutes the only agricultural area of this region. West of Karenko and stretching southward to Pinan is an outcropping of limestone of no great thickness. From Karenko northward, hard, crystalline schistose rocks prevail and these form the famous seacliffs of northeast Formosa. These cliffs seen from the sea appear to be vertical walls of rock fully 2600 m. tall.

The west coast is separated from China by the Formosa Channel, which is nowhere more than 100 fathoms deep. The short rivers that flow from the mountains bring down annually enormous quantities of detritus, spreading it out over the alluvial plains which are constantly increasing in size. Many of the foothills abutting on the plain are worn into terraced flats with vertical faces. About 80 miles south of Taihoku an east and west range of hills extends to the sea and exercises a strong influence on the climate. Owing to the influence of the Japan current which flows up the east coast the mean temperature is higher and the rainfall more copious than in the corresponding latitudes on the continent. The rainfall varies considerably in different parts of the island. At Keelung in the north it averages about 130 inches, while at Taihoku, only 17.8 miles south and one hour's journey by train, it is about 76 inches. At Takao in the south it is about 70 inches, and at Koshun about 84 inches. Thanks to the range of hills which bisect the island the wet and dry seasons of the northern and southern parts of Formosa alternate.

The rich plains on the west coast support a large agricultural population. Rice, of which two crops are harvested each year, is the staple, while in recent years sugar-cane has been grown in enormous quantities. The alluvial areas have nearly all been brought under cultivation. In the north the foothills are also largely given over to agriculture, and the Camphor-tree in great quantities has been planted. In the central parts of the island are several upland valleys, really old lake beds, and these too are under crops. Of the many lakes which at one time existed in this region only one, Lake Candidius, remains. In the north and centre the Tea-plant is grown in quantity and the "Oolong Teas" of Formosa are famous. In places Citronella-grass is cultivated for its oil, while Bananas, Betle-nut Palm and the Longan-tree are features round homesteads at low altitudes. Where



not cleared for cultivation, the foothills are covered with a dense jungle-growth of coarse grasses, Bamboos, miscellaneous shrubs and trees of no great value. At one time the Camphor-tree was prominent on these foothills, but it has long since been destroyed for the sake of its camphor.

The higher mountains are densely clothed with magnificent evergreen forests. The upper slopes of some of these mountains like Mt. Sylvia, are, however, treeless. Others, like Mt. Morrison, the highest of all, is tree-covered to within a few hundred feet of its summit which carries snow for fully six months of the year. Into these wild, densely forested mountain-fastnesses the head-hunting aborigines have been forced by agricultural Chinese who occupy all the valleys. Over 7000 square miles of the island is recognised as savage territory. Some of the tribes have been brought under control, but the majority of them live in a state of war against Japanese authority and against their neighbors. A well-organized system of military police is maintained with a chain of block-houses, and all trade with the savages is done in barter and through the police stations. Fenced guard-lines of wire charged with heavy voltage of electricity are used to segregate the unfriendly tribes.

On the west coast, a railway runs from Keelung in the north to Takao in the south and on the east coast there is about 50 miles of railway from Karenko south. There are several short lateral railways and an extensive system of push-trolley lines built for the purpose of bringing down the products of the foothills and the interior valleys to the railways; there is also a railway constructed specially for the purpose of bringing down the timber felled on Ari-san to the town of Kagi. These railway and trolley lines afford ready facilities as far as they go, but really only very limited distances can be covered by their aid. Owing to the fact that so much of interior Formosa is in the hands of head-hunting Savages travel off the main routes, except by special permission of the Japanese government, is not allowed. The only roads into the mountains are those which have been made for police purposes and these are well guarded. The Government was very gracious toward me on the occasion of my two visits to Formosa. It placed every convenience at my disposal and did its utmost to further the objects I had in view, and, thanks to this invaluable assistance, I was able during the six months I was there to see much of the island. I traveled all round it using the railways on the west coast and staying off at convenient places. From the terminus beyond Ako I went on foot to Koshun over the coral formations in the south. From Taihanroku, the port of Koshun, I went by ship to Pinan; from Pinan by push-trolley I traversed the interior valley already mentioned until the railway-head about 50 miles below Karenko was reached. From Karenko I journeyed on foot over the famous sea-cliffs of northeast Formosa to the little port of So-ō, near Giran. I had previously traveled overland from Taihoku to Giran and returned by way of Keelung. I visited Mt. Taihei situated in the northeastern part of the island and famous for its wonderful Chamaecyparis-forests. In the centre of the island I visited Mt. Kiraishiu which is

beyond Horisha and 3353 m. high. I paid two visits to Ari-san and from there journeyed over the mountains eastward and ascended to the summit of Mt. Morrison. Several other districts were visited including the mountains of Shinchiku prefecture and the volcanic area of Mt. Daiton northwest of Taihoku. It is thus apparent that I had ample opportunities for seeing and gathering information about the flora of the island. Furthermore, to my great good fortune Mr. R. Kanehira, Director of the Government Experimental Station of Forestry, and his assistant, S. Sasaki, were my companions on many trips including that to the summit of Mt. Morrison. On other excursions Y. Shimada accompanied me. These gentlemen have a very intimate knowledge of the flora which they freely imparted, and but for their help and tuition I should have been lost among the wealth of species and forms. It is with great pleasure that I recall the delightful days we spent together and the earnestness with which they labored to make my journeys pleasant and profitable. To them and to the Government of Formosa my best thanks are now offered for the help they gave which contributed so largely toward the success of the Arnold Arboretum Expedition.

On the mountains of Formosa are the finest forests of eastern Asia and the largest (*Chamaecyparis formosensis* Matsum.) and the tallest (*Taiwania cryptomerioides* Hay.) coniferous trees known outside of California. From sea-level upward the dominant forest-features are Tree Figs, Lauraceae, evergreen Fagaceae and Conifers. No Cycad is indigenous and of the three genera of Taxaceae found in Formosa only Podocarpus is common. Pinaceae is represented by 11 genera and on the higher mountains its members form extensive forests both mixed with broad-leaf trees and pure. Considering the warm climate, the Palm family is poorly represented by five genera and of these only *Phoenix Hanceana* Naudin, *Didymosperma Engleri* Warb. and *Calamus Margaritae* Hance are common. The Calamus is one of the principal lianas of the forest and yields slender rattans of excellent quality. The broad-leaf trees are mostly evergreen and dominate from sea-level up to altitudes of 2000 m. Deciduous-leaved trees are comparatively rare though in certain districts *Liquidambar formosana* Hance is common, and in open alluvial areas and mountain valleys like those beyond Horisha and elsewhere in Nanto prefecture forms pure woods. More plentiful is *Alnus formosana* Mak., perhaps the most common deciduous-leaved tree on the island. It is found from sea-level to 2500 m. altitude and is the first tree to spring up on bare slopes and after landslides. On its roots a nitrifying mycorrhiza is found as on other species of Alnus. The usefulness of this tree as a fertilizing agent is well-known to the Savages who plant it in their exhausted Millett fields for the purpose of restoring fertility, and after a few years cut it down and plant Millett again.

Such northern genera as Fagus, Ulmus, Carpinus, Malus and Alnus reach the southern limits of their range in Formosa, and deciduous-leaved Oaks are represented by one species (*Q. variabilis* Bl.) only, and this, though it occasionally forms pure woods as beyond Horisha and Musha, does not grow to a large size. The presence of an endemic species of Beech



(*Fagus Hayatae* Palib.) is very remarkable; the species is well-characterized by its very small fruit on a short peduncle and also by its small leaves. Its distribution is very local and unfortunately I did not see this tree. An endemic species of Walnut grows high up on the mountains west of Karenko, and round Ari-san and elsewhere a species of Sassafras, making the third known species of the genus. Several species of Willow are indigenous in Formosa, but no Poplar, Birch nor Chestnut have yet been discovered, neither has any species of Magnolia though representatives of the related genera *Michelia* and *Illicium* are common forest trees.

In general the climate of Formosa is warm-temperate; at sea-level many sub-tropical species are found and high up on the mountains grow many cool-temperate plants. There is the usual coastal fringe of species widespread within the sub-tropical regions, and, in the extreme south especially, quite a number of Philippine species occur. Among trees two such typical Japanese genera as *Chamaecyparis* and *Trochodendron* are important and prominent forest-features. Nevertheless, among the woody plants Chinese forms abundantly predominate and, as will be demonstrated later, the real affinity of the Formosan flora is with that of central and western China.

Before proceeding with an account of my own observations it may be well to record the present state of our knowledge of the flora as told in books.

Prior to the ceding of Formosa to Japan by China in 1895 our only knowledge of its flora was from small collections made chiefly by various officers of the British Consular Service and of the Chinese Imperial Maritime Customs Service. The first plants were collected round Tamsui by R. Fortune in April 1854, and in 1858 Charles Wilford collected at various places on the north coast. These pioneers were followed by R. Oldham, R. Swinhoe, W. Hancock, G. M. Playfair, T. Watters, C. Ford, Steere, Warburg and others who made small collections near the coast. In 1893 and 1894 A. Henry collected round Takao and through a lighthouse-keeper, named Schmüser, secured a number of plants from savage territory round the South Cape (Garambi). In 1896 Henry published in the *Transactions of the Asiatic Society of Japan* (xxiv. Suppl.) with descriptive notes a "List of Plants from Formosa." This list includes 1429 plants of which 1283 are flowering plants, 131 Ferns and 15 Fern-allies. In the *Kew Bulletin of Miscellaneous Information* for March, 1896, there is published an account of the flora of Formosa by A. Henry, taken from the Foreign Office Report on Formosa prepared by Mr. Perkins of the British Consular Service stationed at Anping (F. O. Commercial No. 1, 1896). These two accounts of Henry's represent the state of our knowledge of the flora of Formosa up to the acquisition of the island by Japan in 1895. In 1904 the Government of Formosa decided to carry out a botanical survey of the whole island the results to be published over a period of fifteen years under the title of *Icones Plantarum Formosanarum*. This survey and the publication of results is still in progress. In the *Actes du III<sup>e</sup> Congrès International de Botanique, Bruxelles, 1910*, there is published a very interesting account of

the flora of Formosa by Dr. B. Hayata. He gives a general history of botanical study in the island, enumerates the collectors, tabulates the principal types found growing in different altitudinal zones, and gives illustrations from a number of excellent photographs. He states that at that time the total number of flowering plants and vascular cryptogams known was 2417 species belonging to 764 genera. In Volume VII of the *Icones Plantarum Formosanarum* issued on March 25, 1918, the figures had risen to 3359 species and 57 varieties belonging to 1173 genera and 169 families. Quite a large portion of the island is still unexplored and the collections made by the lamented Père U. Faurie and by W. R. Price have not yet been wholly determined. So notwithstanding the great progress made since the Japanese undertook a botanical survey of the island it cannot be said that the flora is exhaustively known. Furthermore, before any accurate idea of its richness in endemic forms is possible it will be necessary to compare them with those of central and western China. Taken on the whole and as far as our knowledge goes Formosa is remarkably poor in endemic genera, but very rich in species of woody plants, especially of trees, and the mountain flora is largely composed of endemic plants.

The coastal flora is not particularly interesting consisting as it does largely of plants widespread in warm-temperate and sub-tropical regions. On the west coast a broad alluvial plain extends from the foothills to the sea which is ever receding. Agriculture claims nearly the whole of the plain and I have never visited a less interesting region. In the north volcanic mountains that have been largely deforested abut on the sea. In the gullies and ravines grow various trees but the slopes and mountain-tops are mostly clad with a tangle of miscellaneous shrubs and coarse grasses. South of Taihoku, the capital city, are low hills similar to those of the volcanic area. In both regions *Pinus Massoniana* Lamb. is common but since this Pine has been much planted by the Chinese it is not possible to distinguish with certainty spontaneous trees. In fact I am by no means convinced that it is really indigenous in Formosa. The Pride of India (*Melia Azedarach* L.) and an Acacia (*A. confusa* Merrill) are also abundant as planted trees, and the latter appears to be indigenous in the extreme south. Other trees of the coastal hills are *Quercus glauca* Thunb., *Meliosma rhoifolia* Maxim., *Celtis sinensis* Pers., *Machilus Thunbergii* S. & Z., *Bombax malabaricum* DC., and various Tree Figs like *Ficus Wightiana* Benth., *F. retusa* L., *F. Harlandii* Benth. and *F. nervosa* Heyne. On the volcanic Daiton range grows a variety of shrubs including *Rhododendron Oldhamii* Maxim., *Pieris ovalifolia* D. Don, several species of *Elaeagnus*, a large-leaved Box which may be *Buxus liukiensis* Mak., *Rosa laevigata* Michx., several *Viburnums*, a *Mahonia*, and *Euscaphis japonica* Dipp.

In the south round Takao the formation is all coral limestone. On the strand which encloses a lagoon at Takao grow such Mangrove-like trees as *Kandelia Rheedii* Wight, *Rhizophora mucronata* Lam. and *Bruguiera gymnorhiza* Lam. and associated with them are *Avicennia officinalis* L. and *Lumnitzera racemosa* Willd. A similar collection of Mangrove-like trees



is said to occur near Keelung in the north but I did not see it. On Ape's Hill, Takao, the dwarf, endemic *Phoenix Hanceana* Naudin is abundant and so too is *Pittosporum formosanum* Hay., *Scolopia crenata* Clos and *Croton Cumingii* Muell. Arg. Such littoral woody plants as *Pandanus tectorius* Soland., *Scaevola Koenigii* Vahl, *Excoecaria Agallocha* L., *Hibiscus tiliaceus* L., *Pongamia glabra* Vent., *Caesalpinia bonducella* Bl., *Clerodendron inerme* Gaertn., *Ipomoea biloba* Forsk. and *Canavalia obtusifolia* DC. are abundant and widely distributed. In the south, especially from Anping to Rokko, *Myoporum bontioides* A. Gray is common; *Freycinetia formosana* Hemsl. is confined to the region round Keelung in the north; *Tournefortia argentea* L. is local, but *T. sarmentosa* Lam. is plentiful and widespread. A feature of the coral-cliffs round Takao is the curious *Euphorbia tirucalli* L. with cylindric, whip-like branchlets. This succulent Tree Euphorbia is considered to be a native of Africa, but it must have been introduced into Formosa from China by early settlers. The seacoast between Boryo and Koshun for many miles is covered with an almost pure growth of *Vitex Negundo* L., and near tide mark *V. ovata* Thunb. abounds. In the same district *Hibiscus mutabilis* L., *Kleinhovia hospita* L., *Cerbera odollam* Gaertn., *Acacia Farnesiana* Willd., *Rauwolfia chinensis* Hemsl. and *Atalantia buxifolia* Oliv. are features, and *Indigofera anil* L., *Abutilon indicum* L., *Urena lobata* L., *Sida rhombifolia* L., *Uraria crinita* Desv. and *Abrus precatorius* L. are wayside weeds. The low hills are clothed with *Acacia confusa* Merrill and on the rocks *Phoenix Hanceana* Naudin grows in abundance but nowhere more so than at Taihanroku, a little seaport village near Garambi, the South Cape of foreign maps. The Cape itself is a bold headland of coral-rock, and inland from it rise curious pillars and fortress-like masses of coral for the most part clothed with a jungle-growth. This region is hot and wind-swept and the vegetation more tropical in character than elsewhere in Formosa. In sheltered gullies I saw the gutta-yielding *Palaquium formosanum* Hay. and the interesting *Diospyros Kusanoi* Hay. and *D. utilis* Hemsl.; the latter has a large, apple-like, flattened fruit covered with short hairs. The stinging *Laportea pterostigma* Wedd. is common and so too are *Sapindus mukorossi* Gaertn., *Gleditsia formosana* Hay., *Cudrania javanensis* Trécul, *Melastoma candidum* D. Don and *Heptapleurum octophyllum* Benth. and many species of Tree Figs, Ilex, Evonymus and Capparis. The region is very rich and I made a good haul of specimens during my brief visit. At Pinan on the east coast I saw little of interest except the Macartney Rose (*R. bracteata* Wendl.) which does not grow on the west coast though it is common in the adjacent coast provinces of eastern China; it may be only an escape in Formosa. Near Pinan and also near Giran in the north grows *Koelreuteria formosana* Hay, which seems to be always a small tree. The flora of the inland valley through which the road to Karenko leads is like that of the foothills and the lower mountains and is both rich and varied. In places *Pinus taiwanensis* Hay. reaches the valleys, and in the rock-strewn beds of shallow rivers and summer-torrents *Pyracantha Koidzumii* Rehd. with its masses of scarlet

fruits arrests attention in autumn and winter. Bushes of *Elaeagnus* in several species are plentiful and here and there grows *Caryopteris incanus* Miq. On the impressive and lofty sea-cliffs north of Karenko the mountain flora descends well toward the sea and there is no well-marked littoral vegetation. The flora of these cliffs is little known and many of the species are peculiar. On them I gathered a new *Rose*, a new *Distylium* and several other interesting plants. At Gukutsu, where a strong-flowing river has burst through to the sea, *Juniperus formosana* Hay. descends to sea-level rocks, and on the faces of vertical cliffs *Hibiscus syriacus* L. with lovely lavender-colored flowers is plentiful. In the descent from the cliffs to the little port of So-ō I gathered the interesting *Abelia ionandra* Hay.; also a *Ficus* with deeply lobed leaves and a species of *Caryopteris*, both new, and each only a few inches high. It took me five days to make this pioneer trip over the sea cliffs of northeast Formosa. The road is exceedingly difficult, not to say dangerous and the weather was far from favorable, but a rich harvest of specimens of interesting plants well repaid me for the fatigue and hardships. From the sea only can a proper estimate of the height and grandeur of these cliffs be obtained, but only by struggling over them can the forest-wealth which clothes all but the most vertical walls be realized. Nearly all the trees are evergreen; *Fagaceae* and *Lauraceae* predominate and their canopy of green almost shuts out the heavens. Camphor-trees are plentiful, *Calamus Margaritae* Hance, *Mucuna ferruginea* Matsum., *Bauhinia Championii* Benth. and other lianas cling about the tallest trees and with rope-like stems bind them together. The forest-floor is choked with a dense growth of Ferns in great variety including *Alsophila* and other tree species. *Alocasia macrorrhiza* Schott with huge dark green leaves is plentiful; various *Araliaceae* are common and among them the Rice Paper-plant (*Tetrapanax papyrifera* K. Koch) with huge panicles of snow-white flowers conspicuous in the dim subdued light of the forest-depth. Everything is dank and luxuriant, and the tense silence is broken only by the dull roar of the waves of the Pacific Ocean dashing themselves against the cliffs some two or three or more thousand feet below. Occasionally a bird flits across the path or a monkey is seen in the tree tops, but these are rare events. The armed Japanese police and the Savages who carried our baggage were all silent as we trudged slowly through the wondrous primeval forests which clothe the upper parts of the world-famous sea-cliffs of northeast Formosa.

The character of the vegetation on the foothills varies according to their nearness or otherwise to districts long settled by Chinese. When near such settlements they have been deforested and are now clothed with coarse grasses, miscellaneous shrubs and trees none of much interest or value. The Camphor-tree and its relatives with other broad-leaf evergreen trees have disappeared from low altitudes except where the Savage has held the utilitarian Chinese in check. Where the unmolested forest remains it is similar in character from near sea-level up to 1800 metres. It is everywhere a rain-forest, and nearly all the woody plants are evergreen. At the



lower levels *Dendrocalamus latifolius* Munro, *Bambusa stenostachya* Hack., *B. Oldhamii* Munro, *B. dolichoclada* Hay. and other species with various Tree Figs are prominent. Above 1000 m. Lauraceae and Fagaceae are the dominant types but *Schima Noronhae* Reinw., *Echinocarpus dasycarpus* Benth., *Elaeocarpus japonicus* S. & Z., *E. decipiens* Hemsl., *Crataeva religiosa* Forst. and other interesting trees are plentiful. All are lofty with clean boles, many of them buttressed at the base. Araliaceae of which *Aralia hypoleuca* Presl, *Fatsia polycarpa* Hay, *Oreopanax formosana* Hay., *Heptapleurum arboricolum* Hay., *H. racemosum* Bedd. and *H. octophyllum* Benth. are noteworthy, and with *Ardisia Sieboldii* Miq. and *Rapanea nerifolia* Mez and various species of *Symplocos*, *Eurya*, *Thea* and *Osmanthus* are the most common of the small trees forming the undergrowth. A Banana (*Musa formosana* Hay.) and *Alocasia macrorrhiza* Schott are abundant and impart a tropical appearance to the forest flora. The interesting *Helicia formosana* Hemsl., *Turpinia arguta* Seem., *T. nepalensis* Wall. and various Tree Ferns are common and so is *Debregeasia edulis* Wedd., a species of *Stachyurus*, and the dwarf Palm, *Didymosperma* Engleri Warb. The steeper the mountains the denser the forest on the floor of which Ferns in great variety luxuriate. Lianas such as *Calamus Margaritae* Hance, *Mucuna ferruginea* Matsum., *Ecdysanthera rosea* Hook. & Arn., *E. utilis* Hay. climb to the tops of the tallest trees, and such root-climbers as *Hydrangea integra* Hay. and *Pileostegia urceolata* Hay. and climbing Figs like *F. pumila* L., *F. foveolata* Wall. and *F. awkeotsang* Hay. clothe their trunks and main branches. Such epiphytic Orchids as *Dendrobium*, *Bulbophyllum*, *Cirrhopetalum*, *Cymbidium*, in many species abound, and in the south grows the lovely *Phalaenopsis Aphrodite* Reich. In more open and drier forests the few deciduous trees mentioned early in this article are to be found. The Alder is the most plentiful and in open places forms pure woods. An Elm (*Ulmus Uyematsui* Hay.) is plentiful above altitudes of 1000 m. in mixed forests and grows to a large size. Several species of Maple grow in this forest zone but are small trees, and this also applies to the species of *Carpinus*. At quite low altitudes *Bischofia javanica* Bl. is common and has a short very thick trunk and massive branches forming a wide-spreading crown. The Liquidambar is also common and so too are an Ash (*Fraxinus formosana* Hay.), *Trema orientalis* Bl., *Rhus javanica* L. and *Prunus punctata* Hook. f. In rather open country round Musha, in central Formosa, a Cherry (*Prunus subhirtella* var. *ascendens* Wils.) is quite a feature in early March, and associated with it grows *Prunus mume* S. & Z. the favorite "Plum-blossom" of the Chinese and Japanese. In the dense forests on steep slopes near Musha the lovely *Prunus campanulata* Maxim. is common and when in flower its red blossoms are seen to great advantage against the dark foil of surrounding evergreen trees. Other handsome flowering trees of this zone are the red-flowered *Illicium arborescens* Hay. and the white-flowered *Michelia compressa* Maxim. both of them with fragrant flowers. Several species of *Styrax* all small trees or large bushes, including *S. formosanum* Matsum., *S. Matsumurae* Perk., *S. suberifolium*

Hook. & Arn. and *S. Hayataianum* Perk. are prominent, and so too is the interesting *Alniphyllum pterospermum* Matsum., a slender tree with bark flaking off and leaving brown scars, and highly tinted autumn foliage. The very distinct *Malus formosana* Kawak. & Koidz., several species of *Eriobotrya* and two of *Paulownia* are also found in this forest zone. Among the Lauraceae the Camphor-tree on account of its economic importance demands first-mention though large trees are rarely seen except in the regions remote from Chinese and Japanese habitations. I saw more trees on the west coast than elsewhere. Several other species of *Cinnamomum* are common, including *C. Kanahirai* Hay., all of great size, but none yield camphor. The genus *Machilus* is very rich in species, one of the handsomest of which, but with bad-smelling flowers, is *M. Kusanoi* Hay. Another genus represented by two species is *Cryptocarya* and these and *Beilschmiedia erythrophloia* Hay. are very common trees. Fagaceae are very rich in species of *Castanopsis*, *Lithocarpus* and *Quercus* many of which have remarkable fruits. Of the first of these genera such species as *C. Junghuhnii* Hay., *C. taiwaniana* Hay. and *C. formosana* Hay. are very lofty trees. Less tall but very interesting is *C. Kawakamii* Hay. with large, Castanea-like fruit and shaggy bark flaking off in thick plates. The *Lithocarpus* are on the whole smaller trees but such as *L. Kawakamii* Hay. with exceptionally large, strongly veined, leathery leaves and *L. castanopsisifolia* Hay. with a large, thick-shelled nut almost completely enclosed in the tuberculate cupule are remarkable species. The loftiest species is *L. amygdalifolia* Hay. which usually has a strongly buttressed bole clean of branches for sixty or more feet. The curious *L. Konishii* Hay. with its flattened inch-broad nuts and shallow cupule is usually a large bush and at best is never more than a slender tree less than thirty feet tall. This and other species are a special feature of the forest round Lake Candidius. Of Oaks *Quercus pseudomyrsinaefolia* Hay. and *Q. gilva* Bl. produce the best timber, but are perhaps less common than other species such as *Q. pachyloma* Seem., *Q. glauca* Thunb., *Q. tomentosicupula* Hay. and *Q. longinix* Hay. The forests of this lower mountain-zone are seen to good advantage in the ascent to Ari-san and in the neighborhood of Keitao, they are, however, finer on Mt. Taihei in Giran prefecture, on the sea-cliffs of northeast Formosa, in Karenko prefecture, and beyond Urai which is only a few miles west of Taihoku, the capital city. Except on the steeper mountains and where hard rock prevails they are unfortunately being destroyed by axe and fire to make way for Sugar and Camphor plantations.

Near Lake Candidius and the town of Horisha *Podocarpus Nakaii* Hay., a species very near *P. macrophyllus* D. Don is common but is a tree of small size. In Giran and Karenko prefectures, *P. nagi* Zoll. & Moritzi is fairly plentiful though I did not see a good tree. But, strictly speaking, Taxaceae are nowhere really well represented. Conifers are rare on the lower mountains. Near Urai the interesting *Libocedrus macrolepis* Benth. & Hook. grows on cliffs and steep, rocky slopes scattered among the broad-leaf evergreens, but unable to withstand the competition is fast disappearing. It is

not a tall tree, but has a short thick trunk and massive branches and is never upright in habit, but inclines usually at an acute angle. Its timber is very valuable and the Chinese from early times have sought it out for making coffins. Another disappearing type is *Keteleeria Davidiana* Beissn. which is known from the forests near Herinbi, a day's journey west of Taihoku, and also from the south of the island. It is now a rare tree, and old stumps I saw testify to the large dimensions it once attained; of living trees I saw none in Formosa comparable in size with those I am familiar with in Hupeh and Szech'uan provinces of China. In Nanto and Pinan prefectures *Pinus taiwanensis* Hay. and *P. morrisonicola* Hay. both descend to this zone, but they really belong to higher altitudes. The first delights in open grassy country where it often forms small woods, but *P. morrisonicola* Hay. is confined to rocks and cliffs where it is not crowded by broad-leaved neighbors. The only other Conifer that rightly belongs to this zone is *Pseudotsuga Wilsoniana* Hay. of which I saw only one tree. I was told of its growing in Karenko prefecture but where I saw it was on the border of Shinchiku and Toyen prefectures on the edge of hostile Savage territory. The tree I saw and gathered cones from was a shapely specimen of no great size. This species is probably identical with *P. sinensis* Dode which grows in Kweichou and Yunnan provinces of southwest China.

Rich as is the vegetation on the lower mountains the forests of Formosa reach their highest perfection between altitudes of 1800 and 3000 m. In this belt mixed with broad-leaf, mostly evergreen, trees Conifers prevail. At the lower level Conifers are rare but higher; they almost entirely supersede the broad-leaf trees. The two *Chamaecyparis* (*C. formosensis* Matsum. and *C. obtusa* var. *formosana* Hay.), *Taiwania cryptomerioides* Hay., *Cunninghamia Konishii* Hay. are confined to these forests, and *Pinus taiwanensis* Hay. *P. morrisonicola* Hay. and *Juniperus formosana* Hay. though found at lower levels are most abundant here, and so is *P. Armandi* Franch. although this ascends to nearly 3800 m. The Spruce (*Picea morrisonicola* Hay.) and the Hemlock (*T. chinensis* Pritz.) are common in the upper limits of these forests. The loftiest tree is the *Taiwania* which rears its small mop-like crown well above all its neighbors. The average height of this tree is from 150 to 180 ft., but specimens exceeding 200 ft. are known. The trunk is sometimes as much as 30 ft. in girth, quite straight and bare of branches for one hundred to one hundred fifty feet. It is a strikingly distinct tree, singularly like an old *Cryptomeria* and both trees suggest gigantic *Lycopods*. In the dense forests the crown is small, dome-shaped or flattened, the branches few and short and one wonders how so little leafage can support so large a tree. When the top is broken by storms, the lateral branches assume an erect position. In the more open forest the branches are massive, wide-spreading and the crown oval or flattened, and on small trees the branchlets are often pendent. The *Taiwania* sheds its small inner branches as do *Cryptomeria*, *Cunninghamia* and *Sequoia*.

The Big Tree of Formosa is *Chamaecyparis formosensis* Matsum. found



throughout this forest-zone but most plentiful between altitudes of 2000 and 2500 m. Its maximum height is about 180 ft. and the girth of the largest tree known is 64 ft. The average height is from 120 to 150 ft. and the girth from 30 to 40 ft. One old felled specimen showed two thousand seven hundred annual rings, so if this be any guide the age of the trees must be from two thousand five hundred to three thousand years, and very few trees of a younger generation are to be found. The trunks of many of the trees are hollow, some mere shells, but very few dead trees occur either standing or on the ground. Some fifty feet or so above the base the trunks divide into from three to several erect stems. The lateral branches are slender, short and spreading, the crown thin and tapering, and much of the foliage is usually brownish. These old trees are far from handsome but the bulk of their enormous trunks is most impressive. The *Cunninghamia* like the *Taiwania* is a rare tree only found here and there in the forest. It is nearly as tall as the *Taiwania* but more slender and is neither impressive nor handsome. At one time these three old types probably formed pure forests, the *Chamaecyparis* at a later date than the others, but unable to withstand the competition of aggressive broad-leaf trees ascending from below, they have lost supremacy. Neither beneath their own shade nor in the dense forests are seedlings or young plants of these trees to be found, but in glades, where landslides have taken place, and on Ari-san, where clearings have been made to accommodate a railroad, young seedling plants of the *Chamaecyparis* in particular are quite common.

Much more handsome is *Chamaecyparis obtusa* var. *formosana* Hay. with its shapely, oval, bright green crown and straight trunk. Its height is about the same as that of the Big Tree, but in girth it is seldom more than thirty feet and usually less. The trunk is solid, of even thickness for a considerable height, and the timber more valuable than that of any other soft-wood tree found in eastern Asia. This tree reaches its maximum development between 2500 and 2800 m. in the Ari-san region, and on Mt. Taihei in Giran prefecture there are wonderful forests of it between altitudes of 2000 and 2500 m. At one time *Pinus morrisonicola* Hay. doubtless formed extensive forests on the more steep and rocky mountains, but to-day it is found scattered or in small groves among mixed trees. It is nowhere abundant, but on Matsu-yama near Ari-san grow the largest trees that I have seen. Between Horisha and Musha it is not uncommon, but the trees are small. It appears to favor cliffs and mountain peaks where it has opportunity to overtop its neighbors. *Pinus Armandi* Franch. is sometimes found on cliffs and among mixed trees, but it is seen to best advantage in open grassy country. West of Ari-san on grass-clad slopes and between Musha and Noko this tree is abundant and attains a far greater size than it does in central and western China. Trees from one hundred to one hundred and twenty feet high and twenty feet in girth of trunk are common. The other Pine (*P. taiwanensis* Hay.) forms pure woods in open country and is rarely found elsewhere. The Juniper prefers rocky places, and may be either a prostrate bush or a shapely little tree with hanging branchlets, and from

20 to 30 ft. tall. Among broad-leaf trees *Trochodendron aralioides* S. & Z. is peculiar to this belt and round Ari-san is particularly abundant growing with the *Taiwania* and the two species of *Chamaecyparis*. It is a much branched, wide-spreading tree with a short trunk often 20 ft. in girth and from 60 to 80 ft. in height. This tree has a very wide distribution northward through Liukiu, Yaku-shima, Kyushu and Hondo to the Nikko region, and the finest trees that I have seen grow in the *Cryptomeria*-forests on Yaku-shima.

The various *Fagaceae* of the lower mountains are also present and dominant among them is *Quercus Mori* Hay. and *Lithocarpus ternaticupula* Hay. The *Lithocarpus* is a small tree, but the *Quercus* is one of the largest and noblest of Formosan Oaks. It grows a hundred or more feet tall and has a broad-topped crown and a very thick trunk clothed with gray bark which flakes off in thick plates. This species worthily commemorates one of the pioneer Japanese explorers and botanical collectors in Formosa. *Lauraceae* decrease rapidly in numbers above 2500 m. altitude, but on the upper parts of Ari-san grow scattered trees of *Sassafras randaiense* Rehd., a recently recognized third member of this interesting genus. Among smaller trees *Adinandra lasiostyla* Hay., several species of *Symplocos* including *S. erio-botryaefolia* Hay. with lamellate pith, *Gilibertia pellucidopunctata* Hay. with polymorphous leaves, *Otherodendron illiciifolium* Hay., *Photinia serulata* Lindl., and various species of *Thea*, *Ilex* and *Osmanthus* are noteworthy. Of large shrubs or small trees with conspicuous flowers mention may be made of *Hydrangea Kawakamii* Hay. with huge deciduous leaves and broad flat corymbs of pink and blue flowers, *Viburnum melanophyllum* Hay. which is related to the Japanese *V. furcatum* Bl., *Photinia niitakayamensis* Hay., which is really a *Stranvaesia*, and has white flowers in corymbs and scarlet fruit, *Prinsepia scandens* Hay., which is not scandent, and has white, fragrant flowers and arching, green branchlets, *Mahonia lomariifolia* Takeda, *Berberis Kawakamii* Hay., *Rhododendron Mori* Hay., *R. Tanakai* Hay., *R. formosanum* Hemsl. and others. Rubi in many species abound, and in open, grass-clad regions beyond Ari-san *Rhododendron rubropilosum* Hay. is common and so too is the lovely *Pieris taiwanensis* Hay. Among the climbers the evergreen *Hydrangea integra* Hay. and *H. integrifolia* Hay., with *Schizophragma integrifolium* var. *Fauriei* Hay., *Rhus orientale* Schneid., *Evonymus Spraguei* Hay., *Kadsura japonica* S. & Z., *Actinidia chinensis* Planch. and other species, *Hedera himalaica* Tobl., *Clematis Mori* Hay. and others, and species of *Smilax* and *Ficus* demand notice. The forest-bed in all but the most intensely shaded places is choked with *Arundinaria niitakayamensis* Hay. and *A. oiwakensis* Hay. These graceful Bamboos with their feathery culms grow from 6 to 10 ft. tall, and form impenetrable jungles and ultimately crowd out all other undergrowth. Epiphytic plants are plentiful including such shrubs as *Rhododendron Kawakamii* Hay., *Vaccinium emarginatum* Hay., *V. caudatifolium* Hay., *Gaultheria Cumingiana* Vidal, *Pachycentria formosana* Hay. and the pinnate-leaved *Pentapanax castanopsisicola* Hay. Different species of *Loranthus* are common

and on *Alnus formosana* Mak. a Mistletoe is a bad pest. Most of the broad-leaf trees have buttressed boles and their average height is from 80 to 120 ft. with a girth of from 9 to 15 ft. Rich in variety is the vegetation of these forests and most impressive are the trees in lofty stature, size and grandeur.

Above 3000 m. broad-leaf trees play a minor part in the composition of the forests. Shrubs, more especially those belonging to northern genera, increase in number and the variety is considerable, but Conifers everywhere predominate. West of Ari-san toward Mt. Morrison up to 3300 m. altitude a Spruce (*Picea morrisonicola* Hay.) and a Hemlock (*Tsuga chinensis* Pritz.) with *Pinus taiwanensis* Hay. and *P. Armandi* Franch. are almost the only large trees. They grow first with broad-leaf trees and higher up on the mountains form pure stands or forests of themselves. At their highest level they are associated with *Abies Kawakamii* Hay. which between 3500 and 3800 m. forms extensive pure forests except for occasional trees of *Juniperus squamata* Lamb. West of Musha on Noko-san and Kiraishiu the Conifer-zone is between 2500 to 3300 m. The Pines have been sufficiently mentioned but the others deserve a word or two. The *Tsuga* is found at altitudes of from 2500 to 3300 m. and in rocky places often forms extensive and semi-pure woods. At its best it is the most picturesquely beautiful of all Formosan Conifers. Trees 30 ft. in girth of trunk with thick, wide-spreading branches forming massive tabuliform crowns and from 80 to 120 ft. tall are common. The bark is nearly white on the outer surface, red-brown within, papery and scaling. Nowhere in my travels have I seen such magnificent *Tsuga*-trees as those which grow round Noko beyond Musha in the western limits of the Nanto prefecture.

The *Picea* I saw only west of Ari-san. It is a lofty tree, in sheltered places fully 150 ft. tall, but usually is less than 100 ft. high and in girth of trunk from 10 to 20 ft. The leaves are dark green and slender and the aspect of the tree decidedly sombre. The bark is gray and separates in round thin scales. The *Abies* is a handsome species with very resinous violet-purple cones, and nearly white bark, scaly and fissured into irregular, oblong plates. It grows from 50 to 120 ft. tall and from 6 to 15 ft. in girth of trunk. On windswept slopes above Noko and at its altitudinal limits on Mt. Morrison it is reduced to a bush from 5 to 8 ft. high. The tree is pyramidal in habit with horizontally disposed branches, and its blunt leaves are dark green above and silvery below. The dwarf Bamboos already mentioned form the principal undergrowth up to about 3500 m. and above this *Rhododendron Morii* Hay. and *R. pseudochrysanthum* Hay. predominate. Occasional bushes of *Ribes formosanum* Hay., *Berberis morrisonicola* Hay., *B. brevisepala* Hay., *B. mingtsensis* Hay., *Lonicera oiwakensis* Hay., *Rosa morrisonensis* Hay., *R. transmorrisonensis* Hay. and other shrubs with *Rubus randaiensis* Hay. and other species occur, and *Sorbus randaiensis* Hay. is a small and fairly common tree. On bare rocks and heath-like pastures *Gaultheria borneensis* Stapf, *Vaccinium Merrillianum* Hay., *Rubus calycinoides* Hay. and *Cotoneaster morrisonensis* Hay. form extensive mats. The *Cotoneaster* has small, shining, evergreen leaves, conspicuous white



flowers and bright scarlet fruits, and is very closely related to *C. Dammeri* Schneid. of central and western China. On the divide beyond Noko I gathered a species with deciduous leaves and red fruits very similar to *C. horizontalis* Decne. abundant in the above mentioned regions in China.

The tops of all the higher peaks of the central range are bare of trees and clothed with grass, various herbs and low shrubs. On Mt. Morrison the tree limit is at about 3800 m. Above this for some 150 m. *Juniperus squamata* Lamb. forms a low impenetrable jungle. In the *Abies*-forests this Juniper is often a handsome tree, sometimes as much as 50 ft. tall and 8 ft. in girth of trunk, with a shapely, nearly oval crown and between this and a low mat closely hugging the ground there is every intermediate condition. On exposed rocks low trees or large bushes of this Juniper with broad irregular crowns and gnarled branches clothed with pendent masses of a silvery gray Lichen (*Usnea longissima* Ach.) are exceedingly picturesque. On Kiraishiu this Juniper covers extensive areas with a dense, low growth.

The crumbling summit of Mt. Morrison, 3985 m. above the sea, is reached by a dangerous path, but the climb is not difficult above the trees. It is bare save for a few herbs, among which an Edelweiss is prominent, occasional low bushes of *Rhododendron pseudochrysanthum* Hay., the tiny *Gaultheria borneensis* Stapf with snow-white bells, prostrate mats of the Juniper and a *Salix*. I reached the summit when a slight but bitterly cold sleet storm was in progress and after sojourning beneath the over-hanging lea of some cliffs two thousand feet below for three days. From the summit a wonderful view embracing the Pacific Ocean on the east, the Formosan Channel on the west and much of the island to the north and south is to be had in clear weather. When on the summit I could not see more than fifty feet in any direction and the strong gale and sleet storm made almost inaudible the banzai cheers with which my Japanese companions and police announced our conquest of the highest mountain in the Japanese Empire and the loftiest peak between the Californian Sierra Nevada and the snow-clad peaks of the Chino-Thibetan borderland.

Hayata in his paper already referred to gives percentage tables which show that the flora of Formosa is specifically as closely related to that of Japan as to that of China. To this I cannot agree. His premises, owing to inadequate comparative knowledge of the Chinese flora due to lack of material and opportunity, are at fault. That Formosa is a continental island is generally accepted. It was probably separated from the mainland of China in Tertiary times, and the dividing channel to-day is nowhere more than 100 fathoms deep. A very natural conclusion would be that the flora is most closely related to that of the east coast provinces of China from the mouth of the Yangtze River southward. And it is really surprising that this is not so. The real affinity, however, is with that of central and southwestern China — that is with that of the provinces of Hupeh, Kweichow, Szech'uan and Yunnan.

I have not had the time necessary to compare material in general gath-

ered in the two widely separated regions. I am positive, however, that in the evergreen Fagaceae and Lauraceae many trees will be found conspecific. A concrete example of this relationship is *Pittosporum daphniphyllloides* Hay. which grows on Ari-san and elsewhere in Formosa and on Mt. Omei and in neighboring mountains in western Szech'uan. Some of the Rubi in the two regions are identical and like the *Pittosporum* are absent from eastern China. Some types, *Rhododendron Mariesii* Hemsl. & Wils. for example, which have their western limits in Hupeh and southeastern Szech'uan are found also in the eastern provinces of China and in Formosa. Among the more unstable modern genera the species are numerous, local in distribution and of minor importance in phytogeographical research. For such work old types are more instructive and as their species are usually limited in number they are more easily dealt with. The absence in Formosa of such types as Nyssaceae, Eucommiaceae, Cercidiphyllum, Euptelea, Magnolia and Hamamelis is puzzling since they are a feature in central and western China. But without magnifying unduly the anomalies we may obtain a better perspective of the problem of phytogeographical relationship if we consider a group like the Conifers and Taxads of Formosa and compare them with their relatives in Japan, eastern China and western China. Of the four species of *Pinus* in Formosa, one Hard Pine (*P. taiwanensis* Hay.) is endemic, and is essentially a mountain species though on the east coast it descends to below an altitude of 300 m. The other *P. Massoniana* Lamb. is confined to low altitude on the northwest and west-northwest parts, and in China is found from sea-level to 1300 m. altitude in all but the colder regions. The White Pine (*P. morrisonicola* Hay.) is endemic, and the Nut Pine (*P. Armandi* Franch.) though abundant in the central and western regions is absent in eastern China but reappears on Yaku-shima, Tanegashima and the southern tip of Kyushu in Japan. The *Abies* of Formosa (*A. Kawakamii* Hay.) is endemic but is closely related to *Abies Faxoniana* Rehd. & Wils. of northwest Szech'uan. The *Picea* (*P. morrisonicola* Hay.) is endemic but its nearest relative is *P. Watsoniana* Masters of western China. The *Tsuga* of Formosa (*T. morrisonicola* Hay.) is identical with *T. chinensis* Pritz. abundant in central and western China but absent from eastern China. The *Pseudotsuga* (*P. Wilsoniana* Hay.), is conspecific with *P. sinensis* Dode of Kweichow and Yunnan. The *Keteleeria* is *K. Davidiana* Beissn. so abundant in central and western China up to 1600 m. altitude. This is instructive since in eastern China grows *K. Fortunei* Mayr, a very distinct species. The *Cunninghamia* of Formosa (*C. Konishii* Hay.) is endemic and the other species of the genus (*C. lanceolata* Hook.) is confined to China. The *Taiwania* first discovered in Formosa is now known to grow wild in the extreme northwest border of Yunnan. The related *Cryptomeria* is purely Japanese being unknown as a wild tree in China and Formosa. *Chamaecyparis*, unknown in the continental areas of the Old World is represented by the gigantic *C. formosensis* Matsum. and another which is apparently identical with the Japanese *C. obtusa* S. & Z. The *Libocedrus* (*L. macrolepis* Benth. & Hook. f.) is confined in Formosa to the

northwest and reappears again in Yunnan. This is curious since its close relative *Fokienia* of eastern China and western Tonking is unknown in Formosa and central and western China. The two *Junipers* of Formosa, *J. formosana* Hay. and *J. squamata* Lamb., abound in central and western China and the last-named in its dwarf form is found as far west on the Himalayas as Sikkim.

Turning to the *Taxads*, no *Torreya* has yet been found in Formosa, the *Cephalotaxus* is rare and apparently an endemic species, but the Yew, also rare, is identical with *Taxus chinensis* Rehd. of central and western China. The species of *Podocarpus* need a thorough investigation. One is certainly *P. nagi* Zoll. & Moritzi indigenous also on the Liukiu Islands and in south Japan, another is very similar if not identical with *P. macrophyllus* D. Don, also indigenous in Liukiu and south Japan. It is possible that of the other recorded species one may be endemic or they may be the same as the above. But the curious thing is that none of them are known to grow wild in China. To sum up, *Podocarpus* and *Chamaecyparis* show an affinity with the flora of Japan, while the other *Taxads* and the *Conifers* and many broad-leaf trees show the connection with that of central and western China. Broadly speaking no real line can be drawn between the temperate floras of Japan, Liukiu, Formosa, China and the Himalayas. The generic types are largely common to the whole vast territory though in number they are richer and more concentrated in central and western China. Narrowed down to species and related species the regions mentioned constitute distinct geographical entities. From this viewpoint the flora of Formosa has closer relationship with that of central and western China than with that of Japan, Liukiu or the fairly adjacent coastal provinces of China.

Thanks to the enlightened policy of the Japanese Government in promoting a botanical survey of Formosa and to the assiduous labors of Dr. B. Hayata much progress toward a knowledge of the rich and varied flora of that island has been made. But we know so little about the flora of China and the regions west to Sikkim that it will be long before exact knowledge of the affinities and geographical distribution of species will be possible. A century hence some botanist may critically analyze and compare the floras of the region I have sketched. Formosa is indeed the "Pearl of the Orient" and her crowning glory are the magnificent forests of ever-green *Lauraceae* and *Fagaceae*, the gigantic *Chamaecyparis* and the lofty *Taiwanias* which clothe her steep and rugged mountains. Preserved from the utilitarian Chinese by the head-hunting custom of the aboriginal population, it is sincerely to be hoped that these forests may not be destroyed by the progressive Japanese.



# NEW SPECIES, VARIETIES AND COMBINATIONS FROM THE HERBARIUM AND THE COLLECTIONS OF THE ARNOLD ARBORETUM <sup>1</sup>

ALFRED REHDER

ROSACEAE (*continued*)

## Sorbus L.

× *Sorbus arnoldiana*, hybr. nov. (= *S. Aucuparia* × *discolor*)

Arbor pyramidalis ramis suberectis vel erecto-patentibus; ramuli juniores fere glabri vel sparsissime villosi; gemmae fusco-purpureae, margine perularum dense et longe ciliato et apice barbato exceptis glabrae vel sparse longe pilosae. Folia 6-7-juga; foliola anguste oblonga, acuta, basi oblique late cuneata vel fere rotundata, 3-5 cm. longa et 0.8-1.4 cm. lata, basis quarta parte inferiore plerumque excepta argute serrata vel interdum ad medium, rarius ultra integra, supra glabra, laete viridia, subtus initio sparse, ad costam densius villosa, maturitate glabra vel secus costam sparse villosa, glaucescentia; petioli 1.5-2.5, rarius 3 cm. longi, ut rhachis purpurascens et initio sparse villosi, mox glabri; stipulae 5-8 mm. longae, digitato-incisae, pleraeque persistentes. Corymbi circiter 10 cm. diam., satis densi, rhachi et ramulis sparse villosi; flores 8-10 mm. diam.; petala ovalia vel late ovata, 3.5-4 mm. longa; stamina petalis subaequilonga; styli 3-4. Fructus subglobosi vel subpyriformes, 7-9 mm. diam., rosei; rhachis et ramuli inflorescentiae glabri et purpurascens.

Cultivated at the Arnold Arboretum (raised from seed of *S. discolor* Maxim. in 1907); specimens collected May 16 and September 26, 1918, *A. Rehder* (type).

This new hybrid was raised at the Arnold Arboretum in 1907 from seed collected from a tree of *S. discolor* Maxim. (*S. pekinensis* Koehne) received in 1902 from the nursery of C. Gebbers, Wiesenburg, Germany. It differs from *S. discolor* in the pubescence of the under side of the young leaflets, the smaller stipules, the shorter petioles, the denser villose inflorescence and in the pink fruits; from *S. Aucuparia* which is apparently the other parent it may be distinguished by the narrower leaflets, the larger, deeply incised and partly persistent stipules, the glabrous or glabrescent winterbuds and by the pink fruit. As it grows in the Arboretum it is a handsome pyramidal tree of vigorous growth now 6 or 7 m. tall and attractive in spring with its numerous dense clusters of white flowers, and in autumn remarkable for the light pink color of its fruits.

## Aronia Pers.

*Aronia arbutifolia* Ell. f. *leiocalyx*, forma nov.

A typo recedit calyce pedicelloque glabris vel fere glabris. — Folia obovata vel obovato-oblonga, subito acuminata, 4-6.5 cm. longa et 1.7-3.8

<sup>1</sup> Continued from vol. I, p. 263.

cm. lata; inflorescentia in parte inferiore satis plus minusve tomentosa, sursum glabrescens.

MASSACHUSETTS: Cedar Pond near Lynn, May 29 and October, 1886, *J. H. Sears* (type); same locality, October 16, 1890 and May 19, 1891, *C. E. Faxon*; Wyoma Lake, near Lynn, May 23, 1903, *A. Rehder*.

The glabrousness of the calyx and the upper part of the inflorescence suggests *A. melanocarpa*, but the leaves are pubescent beneath and the fruit is bright red and ripens in October. Specimens with similar pubescence I have seen from Maine, Virginia and South Carolina, but in the absence of fruits it is impossible to say if they belong here or to *A. floribunda*. This new variety is apparently not identical with *A. arbutifolia* b. *glabra* Elliott (Sketch Bot. 1. 557 [1821]) which is described as having a glabrous calyx and the leaves a little hairy beneath while young, and glabrous at maturity, while in our form the leaves are tomentose beneath as in the type.<sup>1</sup>

*Aronia arbutifolia* var. *pumila*, comb. nov. — *Mespilus pumila* Schmidt, Oester. Baumz. II. 39, t. 88 (1794). — Krauss, Afbeeld. Boom. Heest. 2 pp., t. (Class XII, Ord. IV.) (1802). — *Pyrus depressa* Lindley in Trans. Hort. Soc. VII. 230 (1827). — *Aronia depressa* Spach, Hist. Vég. II. 90 (1834). — *Pyrus arbutifolia* 4. *pumila* Loudon, Arb. Brit. II. 926, fig. 647, 648 (1838). — *Sorbus depressa* Heynhold, Nomencl. Bot. 772 (1840). — Hedlund in Svensk. Vetensk.-Akad. Handl. XXXV. No. 1, 116 (Monog. Sorbus) (1901). — *Sorbus arbutifolia* var. *depressa* Schneider, Ill. Handb. Laubholzk. I. 698 (1906). — *Aronia arbutifolia* var. *depressa* Schneider in Fedde, Rep. Sp. Nov. III. 150 (1906).

This is a dwarf form with creeping and rooting stems, small leaves and dark red fruits. I have little doubt that Lindley's *Pyrus depressa* is the same. Its dark purple fruits are described as downy, as are those of *Mespilus pumila*, which excludes *A. floribunda* with glabrous lustrous fruit. Specimens from Newfoundland agree in habit with the plant figured by Schmidt, but the color of the mature fruit of the Newfoundland plant is not known.

*Aronia arbutifolia* f. *macrophylla*, comb. nov. — *Pyrus arbutifolia* var. *macrophylla* Hooker in Comp. Bot. Mag. I. 25 [1835], nomen.

A typo recedit foliis majoribus usque ad 8 vel 9 cm. longis et interdum habitu arborescente.

LOUISIANA. Orleans Par'sh: New Orleans, 1833, *T. Drummond* (type, photograph seen); St. Tammany Parish: Covington, *T. Drummond* (photograph seen); Folsom, April 20, 1920, *R. S. Cocks* (Nos. 3332, 3333).

ARKANSAS. Hot Springs County: Malvern, June 23, 1915, *E. J. Palmer* (No. 8108).

TEXAS. San Augustine County: San Augustine, September 19, 1918, *E. J. Palmer* (No. 14460); Bland Lake, margin of sandy bog, April 2, 1918, *E. J. Palmer* (No. 13264).

<sup>1</sup> There was no specimen of this variety to be found in the Elliott herbarium preserved in the Charleston Museum, Charleston, S. C., but in the local herbarium I noticed a specimen from the Chicora woods, collected March 28, 1913, which answered Elliott's description and was stated to have "red berries."

This form differs from the type in the larger leaves which are up to 8 cm. long and 3.5 cm. wide in Drummond's specimen of which we received excellent photographs through the kindness of Dr. Prain; in Cock's No. 3333 they attain 9 cm. in length and 4 cm. in width. Palmer's Texas specimens came according to his notes from slender trees from 5 to 7 m. tall. The form with large leaves described as *A. arbutifolia* var. *Baenitziana* Schneider probably belongs to *A. floribunda*, as its fruit is fully ripe in August.

*Sorbus arbutifolia* var. *xanthocarpa* Hedlund (*Mespilus xanthocarpa* Loddiges<sup>1</sup>) and *S. arbutifolia* var. *leucocarpa* Hedlund (*Pyrus arbutifolia* γ *alba* Willdenow) are unknown to me, and there is no reliable record in literature of forms with yellow or white fruit. Forms with large fruits have been named *A. arbutifolia* f. *macrocarpa* Zabel (in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 192 [1903], nomen).

*Aronia floribunda* Spach. Hist. Vég. II. 89 (1834). — *Pyrus floribunda* Lindley in Bot. Reg. XII. t. 1006 (1826); Trans. Hort. Soc. VII. 229 (1827?)<sup>2</sup> — ? *Pyrus melanocarpa* β *subpubescens* Lindley, l. c. (1827?). — *Sorbus floribunda* Heynhold, Nomencl. Bot. 773 (1840). — ? *Sorbus melanocarpa* β *subpubescens* Heynhold, l. c. (1840). — ? *Aronia nigra* b. *pubescens* Dippel, Handb. Laubholz. III. 386 (1893), pro parte. — *Pyrus arbutifolia* var. *melanocarpa* f. *pubescens* Rand & Redfield, Fl. Mt. Desert, 98 (1894). — *Aronia atropurpurea* Britton, Man. 517 (1901). — Britton & Brown, Ill. Fl. ed. 2, II. 291, fig. 2327 (1913). — Nash in Addisonia III. 1, t. 81 (1918). — *Sorbus arbutifolia* var. *atropurpurea* Schneider, Ill. Handb. Laubholz. I. 698 (1906). — *Aronia arbutifolia* var. *atropurpurea* Schneider in Fedde, Rep. Sp. Nov. III. 150 (1906). — *Pyrus arbutifolia* var. *atropurpurea* Robinson in Rhodora, x. 33 (1908). — *Adenorhachis atropurpurea* Nieuwland in Am. Midl. Nat. IV. 94 (1915). — *Pyrus atropurpurea* Bailey in Rhodora, XVIII. 154 (1916). — *Pyrus melanocarpa* var. *atropurpurea* Farwell in Rep. Mich. Acad. Sci. XIX. 258 (1917).

This species is intermediate in its characters between *A. arbutifolia* and *A. melanocarpa* Elliott, resembling in its pubescence the first species and in its fruit the second. Therefore *A. floribunda* has been considered by some botanists, first apparently by Koehne (Deutsch. Dendr. 254 [1893]), a hybrid between these two species, but its wide distribution from Newfoundland or Nova Scotia to Florida and west to Michigan and Indiana and its occurrence in regions where only one or neither of the parents grow, is not in favor of this theory, though possibly hybrid forms occasionally occur which it seems impossible to distinguish from this species.

<sup>1</sup> Upon *Mespilus xanthocarpa* Loddiges, the fruit of which was unknown to him, Lindley based his *Pyrus melanocarpa* β *subpubescens* which probably belongs to the following species.

<sup>2</sup> As the date of Lindley's publication usually the date of the title page, 1830, is cited, but the volume was published in parts and Lindley's article must have appeared between 1826 and 1828, as he does not cite it in 1826, while in 1828 he quotes it under plate 1154 of the Botanical Register.



*Photinia* Lindl.

*Photinia villosa* DC. var. *coreana*, comb. nov. — *Pourthiaea coreana* Decaisne in Nouv. Arch. Mus. Paris, x. 148 (1874). — *Pirus mokpoensis* Léveillé in Fedde, Rep. Nov. Spec. x. 200 (1909). — *Pourthiaea villosa* var. *coreana* Nakai in Tokyo Bot. Mag. xxx. 25 (1916).

This variety differs from the type chiefly in the thinner, long-acuminate leaves and usually attenuate at the base, in the somewhat longer (3–6 mm. long) petioles and in the slenderer pedicels and branches of the inflorescence which is villous or sometimes only slightly so. It occurs in Korea and Japan.

*Amelanchier* Med.

× *Amelanchier grandiflora*, hybr. nov. (= *A. canadensis* × *laevis* Wiegand in herb.) — *A.?* *Botryapium lancifolia* Simon-Louis apud Zabel, Syst. Verz. Muenden, 19 (1878), nomen. — *A. canadensis grandiflora* Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 191 (1903), nomen. — *A. lancifolia* hort. gall. ex Zabel, l. c. (1903), pro synonym.

Arbor vel frutex ramis patentibus gracilibus; ramuli juniores initio floccoso-villosi, mox glabri, annotini purpureo-fusci. Folia ovata vel oblongo-ovata, breviter acuminata, basi subcordata, 4–10 cm. longa et 2.5–4 cm. lata, subaequaliter argute serrata, initio glauco-purpurea et supra laxe, subtus satis dense tomento sericeo-floccoso cito evanescente oblecta, maturitate glabra, supra opace viridia, subtus glauca, utrinsecus nervis 7–12 conspicuis; petioli 1.2–2 cm. longi, initio sericeo-villosi, mox glabri. Racemi plerique pendentes, flexuosi, 5–10 cm. longi, 8–10-flori, laxissime sericeo-villosi, purpurascens; pedicelli inferiores 1.5–2.2 cm. longi, apicem versus decipientes; calyx extus glaber vel fere glaber, purpurascens; sepala triangulari-vel ovato-lanceolata, acuminata, 4–5 mm. longa, sub anthesi initio erecti, mox reflexi; petala oblongo-oblancheolata, 1.3–1.6 cm. longa et 5–6 mm. lata; ovarium apice glabrum; hypanthium late campanulatum. Fructus atropurpurei, leviter glaucescentes, 7–8 mm. diam., succulenti, dulces, sepalis reflexis, pedicellis inferioribus 1.7–2.5 cm. longis.

Cultivated specimens: Bot. Gard. Muenden, April 23 and July 3, 1893, *A. Rehder* (type); Arnold Arboretum under No. 4406 (received from Muenden in 1892). May 11, 1900, May 3, 1902, June 22, 1903, May 11 and July 6, 1912, May 14 and May 5, 1919; Arb. Spaeth, Berlin, May 8, 1909, *H. Jensen* (as *A. canadensis*).

The following spontaneous specimens in the herbaria of the Arnold Arboretum and of the New England Botanical Club and in the Gray Herbarium have been referred to this hybrid by Dr. K. M. Wiegand:

ONTARIO. Kingston, May 15, 1902, *J. Fowler*.

VERMONT. Windham County: Westminster, April 30, May 15, 1903, and (North) Westminster, Rod. Smith's pasture, May 3 and 10, 1903, *W. H. Blanchard* (distributed as *A. intermedia*). Rutland County: Noyes swamp, Pittsford, May 6, 1899, *W. W. Eggleston* (No. 1183); Rutland, July 7, 1899, *G. H. Ross* (Eggleston, No. 1118).

NEW HAMPSHIRE. Sullivan County: Summer's Falls, Plainfield, July 27, 1900, *W. W. Eggleston* (No. 1958).

CONNECTICUT. Hartford County: May 7 and June 16, 1901, May 8, June 13 and September 1, 1901, May 8 and June 9, 1901, *C. H. Bissell*; Glastonbury, May 14, 1913, *C. A. Weatherby* (No. 2863a); Tariffville, May 17, 1903, *E. J. Winslow & A. F. Hill*. New Haven County: banks of Mad River, May 1, 1913, *A. E. Blewitt* (No. 1800).

RHODE ISLAND. Providence County: Lime Rock, June 4, 1913, *C. F. Batchelder*; Lincoln, July 13, *M. L. Fernald*.

NEW YORK. Monroe County: Seneca Park, Rochester, May 4, 5, 18, June 21, July 6, 1905, *B. H. Slavin* (Nos. 1, 3, 8, 16). Chemung County: Latter Brook, May 13, 1898, *T. F. Lucy* (No. 5). Tompkins County; Fall Creek, Ithaca, 1885, *W. R. Dudley* (No. 54).

PENNSYLVANIA. Erie County: Presque Isle, May 8-9, 1906, *O. E. Jennings*. Lancaster County: mouth of Tucqan, April 29, 1893, *A. A. Heller & E. G. Halbach* (No. 1365).

VIRGINIA. Smyth County: Stalie's Knob, East Marion, May 18-19, 1892, *J. K. Small*; south fork of Holston River, east of Add Wolf, August 8, 1892, *J. K. Small*. Alexandria County: south of Alexandria, April 28, 1901, *G. S. Miller*.

NORTH CAROLINA. Rowan County: April 24, 1916, *T. G. Harbison* (No. 3).

GEORGIA. Richmond County: Augusta, May 22, April 6, 1900, *A. Cuthbert* (No. 2).

INDIANA. Warren County: two miles north of Attica, April 21, May 15, 1917, *C. C. Deam* (No. 22524). Ripley County: seven miles south-east of Versailles, June 18, 1915, *C. C. Deam* (No. 16116). Wells County: one mile below Vera Cruz, May 8, 1915, *Mrs. C. C. Deam* (No. 15582).

ILLINOIS. Jackson County: Grand Tower, May 3, 1902, *H. A. Gleason* (No. 2404); Tower Rock, May 7, 1902, *H. A. Gleason* (No. 2405).

MISSOURI. Marion County: Hannibal, August 28, 1911, *J. Davis* (Nos. 704, 713).

MICHIGAN: Marquette County: Turin, May 18, 1901, *B. Barlow*. Arenac County: Au Gres, June 21, 1912, *C. K. Dodge* (No. 4); Wayne County: Detroit, May 12, 1856 (*Herb. W. Boott*).

The specimens cited above are all intermediate in their characters between *A. canadensis* and *A. laevis* and there can be little doubt that they represent hybrid forms between these two species. The hybrid, as represented by the plants in the Arnold Arboretum differs from *A. canadensis* in the larger flowers, the longer and slenderer less pubescent racemes, in the purplish young leaves covered with a less dense, more floccose tomentum which soon disappears entirely; from *A. laevis* it differs in the tomentose young leaves, the slightly villose racemes with more numerous flowers on shorter pedicels and in the larger, more succulent fruit. Among the many *Amelanchier* grown at the Arboretum it is easily the most handsome and always attracts attention by the abundance of its large flowers set off effectively by the purplish foliage; it forms a large tree-like shrub with wide-spreading slender branches. As I saw it in 1893 in the Botanic Garden of the Forest Academy at Muenden it formed a well-shaped small or medium-sized tree with spreading branches; it had been received from the nursery of Simon-Louis near Metz as *A. lancifolia*, a name which apparently was never published.

*Amelanchier grandiflora* f. *rubescens*, f. nov.

A typo recedit floribus in alabastro intense purpureo-roseis, sub anthesi leviter roseo suffusis.

Cultivated in the Durand-Eastman Park, Rochester, New York; specimens collected: May 16, 1920, *B. H. Slavin & J. Dunbar*.

This handsome form agrees in its characters with the type except that the flowers are purple-pink in bud and suffused with pink when open. It is a seedling from a tree of typical *A. canadensis* growing in Seneca Park, Rochester, and represented in our herbarium by specimen collected by B. H. Slavin and marked No. 10. The seedling described above, however, shows unmistakably the influence of *A. laevis* which is growing at the same locality.

### *Malus* L.

In the following conspectus of the genus *Malus* thirty-two species are recognized, including *Eriolobus* which had been considered by some botanists a distinct genus. These thirty-two species fall easily into several distinct and apparently natural groups which call for a systematic arrangement under sections and subsections to bring out their relationship. The first division of the genus into sections was proposed in 1893 by Koehne, who divided it into the sections *Calycomeles* and *Gymnomeles* according to the behavior of the calyx whether persistent or deciduous. Ten years later Zabel considering the veneration of the leaves the most important character proposed the section *Eumalus* with involute and never lobed leaves and the section *Sorbomalus* with conduplicate and more or less lobed leaves. In 1906 Schneider added two new sections, *Eriolobus* corresponding to the genus of that name, and *Docyniopsis* containing *M. Tschonoskii* which I had referred in 1903 to the genus *Eriolobus* chiefly on account of the presence of copious grit-cells in the fruit; this character, however, I do not now consider important enough for generic distinction and I am following Schneider in referring *Eriolobus* to *Malus*.

SECT. I. EUMALUS Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 185 (1903), nomen. — Schneider, Ill. Handb. Laubholz. 1. 714 (1906). — Leaves involute in bud, never lobed; fruit without grit-cells.

Subsect. 1. PUMILAE, subsect. nov. — *M.* sect. *Calycomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — Calyx persistent: styles 5; fruit about 2 cm. thick or larger.

1. *M. pumila* Mill. — 2. *M. sylvestris* Mill. — 3. *M. prunifolia* Borkh. — 4. *M. spectabilis* Borkh. — The species of this subsection are closely related. — Europe, western to eastern Asia.

Subsect. 2. BACCATAE, subsect. nov. — *M.* sect. *Gymnomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — Calyx deciduous: styles 3-5; fruit small, not exceeding 1.5 cm.

5. *M. sikkimensis* Koehne. — 6. *M. baccata* Borkh. — 7. *M. theifera* Rehd. — 8. *M. Halliana* Koehne. — The species of this subsection are closely related except *M. sikkimensis* which seems to have some relation to *M. Prattii* and *M. yunnanensis*. — Eastern Asia, Himalayas.

SECT. II. SORBOMALUS Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 721 (1906), nomen. — Schneider, Ill. Handb. Laubholz.



1. 721 (1906). — *M. sect. Gymnomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — Leaves conduplicate in bud, usually more or less lobed: calyx deciduous or sometimes persistent: styles 3-5: locules of ovary not extending with their apex to the base of style and core of fruit not protracted into a free pointed apex; fruit without or with few grit-cells.

Subsect. 3. *SIEBOLDIANAE*, subsect. nov. — Calyx caducous, leaving a large shallow scar: styles 3-5, villous at base: leaves of flowering branchlets not lobed; those of shoots partly 3-5-lobed, rarely not lobed: fruit subglobose, without grit-cells, small.

9. *M. floribunda* Sieb. — 10. *M. zumi* Rehd. — 11. *M. Sieboldii* Rehd. — 12. *M. Sargentii* Rehd. — The species of this group are all closely related. — Japan and Korea.

Subsect. 4. *KANSUENSES*, subsect. nov. — Calyx usually tardily deciduous, leaving a small deeply impressed scar, sometimes partly or wholly persistent: styles 3-5, glabrous: all leaves more or less lobed except in *M. fusca*: fruit ellipsoidal, without or with few grit-cells.

13. *M. fusca* Schneid. — 14. *M. transitoria* Schneid. — 15. *M. kansuensis* Schneid.<sup>1</sup> — 16. *M. Komarovii* Rehd. — 17. *M. honanensis* Rehd. — The first two species of this group form a transition to the preceding subsection on account of the absence of grit-cells in the fruit and of dots on the fruit and the first also in its only partly three-lobed leaves. The following two species have their fruits dotted and with a few grit-cells; of the last species which forms by the shape of its leaves a transition to the subject. *Yunnanenses* the fruit is not yet known. — Western North America, eastern Asia.

Subsect. 5. *FLORENTINAE*, subsect. nov. — Calyx deciduous: leaving a small deeply impressed scar: styles 5, villous at base: all leaves lobed with several lobes on each side: fruit broadly ellipsoidal, without grit-cells.

18. *M. florentina* Schneid. — Italy.

Subsect. 6. *YUNNANENSES*, subsect. nov. — Calyx persistent: styles 5, glabrous or nearly so: leaves slightly lobed with several lobes on each side or not lobed: fruit subglobose, about 1 cm. across, dotted, with grit-cells.

19. *M. Prattii* Schneid. — 20. *M. yunnanensis* Schneid. — The first species seems to have some relation to the subsect. *Kansuenses*, while *M. yunnanensis* has leaves similar to those of *M. Tschonoskii*. — Western China.

SECT. III. *CHLOROMELES*, sect. nov. — *Chloromeles* Decaisne in Fl. des serres, xxiii. 156 (1881). — *M. sect. Calycomeles* Koehne, Deutsch. Dendr. 257 (1893), pro parte. — *M. subsect. Coronariae* Rehder in Sargent, Trees & Shrubs, II. 142 (1911). — Leaves conduplicate in bud, at least the leaves of shoots lobed, rarely without lobes: calyx persistent: styles 5, villous at base; anthers red or reddish; locules of ovary extending with their apex above base of style and core of fruit with free pointed apex: fr. subglobose or depressed, 2-5 cm. across, green or yellowish green, not dotted, without grit-cells.

<sup>1</sup> The styles of this species are glabrous in our specimens, not pilose as described by Batalin.

21. *M. platycarpa* Rehd. — 22. *M. coronaria* Mill. — 23. *M. glaucescens* Rehd. — 24. *M. glabrata* Rehd. — 25. *M. bracteata* Rehd. — 26. *M. lancifolia* Rehd. — 27. *Malus angustifolia* Mill. — 28. *M. ioensis* Britt. — This is a very distinct and at the same time homogeneous group; its species are so closely related that some authors have considered them as all belonging to one species. The type of the section is *Malus angustifolia*, the species upon which Decaisne based the genus *Chloromeles*. — Eastern North America.

SECT. IV. *ERIOLOBUS* Schneider in Fedde, Rep. Sp. Nov. III. 179 (1906). — *Pyrus* sect. *Eriolobus* Seringe in De Candolle, Prodr. II. 636 (1825). — *Eriolobus* Roemer, Syn. Monog. III. 216 (1847). — *Cormus* sect. *Eriolobus* Decaisne in Nouv. Arch. Mus. Paris, x. 157 (Mém. Fam. Pomac.) (1874). — *Eriolobus* sect. *Eueriolobus* Schneider, Ill. Handb. Laubholz. I. 725 (1906), pro parte. — Leaves conduplicate in bud, all deeply lobed, calyx persistent, with reflexed lobes; styles 5, villous at base; stamens 20–30; locules of ovary extending with their apex into base of style and core of fruit pointed and free at apex; fruit ellipsoidal, with grit-cells.

29. *M. trilobata* Schneid. A very distinct species which has no close relation to any other species. — Western Asia.

SECT. V. *DOCYNIOPSIS* Schneider in Fedde, Rep. Sp. Nov. III. 179 (1906). — *Eriolobus* Rehder in Sargent, Trees & Shrubs, I. 74 (1903), pro parte. — Leaves conduplicate in bud, not or very slightly lobed; inflorescence 2–5-flowered; calyx persistent, with upright lobes; stamens 30–50; styles 5, villous at base; locules of ovary extending into base of style and core of fruit pointed and free at apex; fruit 2–4 cm. across, dotted, with grit-cells.

30. *M. Tschonoskii* Schneid. — 31. *M. formosana* Kawak. & Koidz. — 32. *M. laosensis* A. Cheval. (*Pyrus laosensis* Cardot). — This group shows a close affinity to *Docynia* and particularly *M. formosana* much resembles in the structure of its flower that genus, but has only two ovules in each cell. *Malus docynioides* placed by Schneider in this section belongs to *Docynia*. — Eastern Asia.

*Malus baccata* Borkhausen f. *gracilis*, forma nov.

A typo recedit habitu humiliore, ramis patentibus ramulis gracilibus pendentibus, foliis ab initio glabris, ovato-oblongis vel oblongo-ellipticis, 5–8 cm. longis et 2–4 cm. latis, basi late cuneatis, crenato-serrulatis, petiolis 1.5–3.5 cm. longis, floribus minoribus, circiter 3 cm. diam., stylis saepe 4, fructibus 0.8–1 cm. longis, late obovoideis vel subglobosis, rubris.

Cultivated in the Arnold Arboretum; plants received from the Veitchian Nurseries in 1913 as *Pyrus* sp. Purdom no. 327; type specimens collected May 14 and October 21, 1919, preserved in the herbarium of the Arboretum.

This form belongs to the typical variety of *Malus baccata* (var. *sibirica* Schneid.), but differs from the commonly cultivated form chiefly in the graceful pendent habit, the comparatively narrower obtusely serrulate leaves with slenderer petioles, in the smaller flower with often only 4 styles and in the small fruits. The white flowers are not fragrant.

The exact native habitat of this form is not known with certainty. Purdom sent under No. 329 flowering specimens of *M. baccata* collected at Yen-an Fu, Shensi, and it is probable that No. 327 under which the plants were received from Veitch is a mistake for 329, as the number 327 is represented by a *Caragana* in his collection. None of his flowering specimens, however, agrees with our plant and no fruiting herbarium specimens of *M. baccata* have been collected by Purdom.

***Malus floribunda* Siebold var. *brevipes*, var. nov.**

A typo praecipue recedit foliis minoribus, floribus minoribus, albidis, circiter 2.5 cm. diam., pedicellis brevibus 0.8–1.5 cm. longis ut calyx glabris, petalis late ovalibus 1–1.2 cm. longis; stylis 3–4 quarta parte tantum connatis ima basi glabris et tantum versus apicem partis connatae sparse vel densius pilosis, fructibus subglobosis circiter 1 cm. diam. pedicello erecto vel suberecto 0.6–1.5 cm. longo suffultis.

Cultivated at the Arnold Arboretum under No. 1850 for many years, originally received as *Pyrus Sieboldii* probably from St. Petersburg; type specimens collected May 19 and October, 1898, preserved in the herbarium of the Arboretum.

This is a very peculiar form which in its leaf-characters agrees with *M. floribunda*, but the flowers are much smaller, only slightly pink, rather short-stalked and the style is more deeply divided and less densely pubescent. The shrub looks particularly distinct in autumn with its more or less upright fruit on rather stout pedicels rarely more than 1 cm. in length. It is not without hesitation that I refer this plant as a variety to *M. floribunda*, but it shows no characters which point to hybrid influence of any other species, and from *M. Sieboldii* it differs in the leaves which never show the slightest tendency toward lobing. It may be nearer to the wild form, *M. floribunda* var. *spontanea* Koidzumi which according to a specimen before me has smaller lighter colored flowers and smaller leaves than the cultivated typical form.

***Malus kansuensis* Schneider f. *calva*, forma nov.**

A typo recedit pedicellis calycibusque extus et foliis subtus ab initio glabris, ramulis et petiolis basin versus sparse pilosis mox glabris.

CHINA. Hupeh: Fang Hsien, alt. 2300 m., May 28 and September, 1907, *E. H. Wilson* (No. 264, flowers [type] and fruit); without exact locality, *A. Henry* (No. 6754), Shensi: Tai-pei-shan, 1910, *W. Purdom* (No. 1118). Western Szechuan: woodlands around Tachien-lu, 2600–3300 m., June, 1908, *E. H. Wilson* (No. 2996); without precise locality, alt. 3000 m., May, 1904, *E. H. Wilson* (Veitch Exped. No. 3495).

This new form is easily distinguished from the type by the absence of pubescence from the inflorescence and the leaves. The original description of Batalin is chiefly based on Potanin's specimens of which he describes the flowers with pubescent pedicels and calyx; in the description of the leaves as "glabra vel subtus in nervis puberula" he apparently includes fruiting specimens of Henry's No. 6754 which belongs to *f. calva*. Batalin's description of the flowers fits exactly Wilson's specimens from Pan-lan-shan under No. 2995 except that he describes the styles as pilose, while



I found them glabrous; in these specimens the young leaves are densely villose on the whole under side and the same pubescence is present in Purdom's specimens from western Kansu, which are in young fruit; the pubescence never disappears entirely and in Wilson's fruiting specimens under 4115 from Pan-lan-shan and Tachien-lu the mature leaves show more or less pubescence beneath, at least on the midrib and the veins.

**Malus Komarovii**, comb. nov. — *Crataegus tenuifolia* Komarov in Act. Hort. Petrop. xvii. 435 (1901); xxii. 470, t. 10 (Fl. Manchur.) (1904), non Britton. — Nakai in Jour. Coll. Sci. Tokyo, xxvi. art. 1, 180 (Fl. Kor. i) (1909); Chôsenshokubutsu, i. 292, fig. 346 (1914). — Schneider, Ill. Handb. Laubholz. i. 771 (1906). — *Crataegus Komarovii* Sargent, Pl. Wilson. i. 183 (1912). — Schneider, Ill. Handb. Laubholz. ii. 1005 (1912). — Nakai, Fl. Sylv. Kor. vi. 62, t. 29<sup>1</sup> (1916).

NORTHERN KOREA: "in jugi Koreani, in silvis mixtis primaevis," June 20 (old style), 1897, *V. Komarov* (No. 862); Tumen-Yalu divide, prov. Kankyo, August 30, 1917, *E. H. Wilson* (No. 9058; bush 1.5 m.); above Kanin between Keizanchin and Choshin, prov. Kankyo, September 11, 1917, *E. H. Wilson* (No. 9143; bush 1-3 m.; fruit reddish); about middle of Mt. Laoling, prov. Kankyo, alt. 1300 m., September 17, 1917, *E. H. Wilson* (No. 9177; bush 1-2 m.; fruit reddish); "secus torrentes montis Sodenrei," July 10, 1914, *T. Nakai* (No. 1573).

*Malus Komarovii* is closely related to *M. kansuensis* and similar to its form *calva*, but is easily distinguished by the short pedicels of the fruit which are only 1-1.5 cm. long (2-3.5 in *M. kansuensis*), by the cordate or subcordate base of the more deeply lobed leaves, the sinus of the lower lobes reaching often more than halfway to the middle, and by the oblong-ovate gradually acuminate spreading or often slightly recurved lower lobes provided usually with a small basal lobe, while in *M. kansuensis* the lower lobes are triangular-ovate and abruptly short-acuminate without basal lobes. The resemblance of the leaves to those of certain *Crataegus* has led Komarov in the absence of mature fruit to place this plant in the genus *Crataegus*, but even before examining the structure of the ovary the racemose inflorescence shows at a glance that it is not a *Crataegus*.

As the first specific name given to this plant is a still-born name, the later valid specific name has to be used for the new combination under *Malus*.

**Malus honanensis**, sp. nov.

Frutex (verisimiliter); ramuli satis graciles, initio laxe floccoso-tomentosi, cito glabri, rubro-brunnei, nitiduli; gemmae juveniles (medio Junio) perulis paucis rubro-brunneis extus glabris margine villosis. Folia late ovata, rarissime oblongo-ovata, vel orbiculari-ovata, acuta, basi truncata vel rotundata, interdum subcordata, 4-7 cm. longa et 3.5-6.5 cm. lata, utrinque lobis 2-5 apicem versus decrescentibus brevibus late ovatis acutis vel obtusiusculis instructa, toto margine subsimpliciter argute serrulata vel interdum crenato-serrulata, initio utrinque laxe villosa-tomentosa, supra

<sup>1</sup> Nakai figures the fruit erroneously with a persistent calyx, but the calyx is finally deciduous, though it remains on the immature fruit a long time together with the remnants of the stamens and the styles.

mox glabra, subtus tarde glabrescentia, reticulo venularum impresso satis conspicuo, nervis utrinsecus circiter 5 rectis sub angulo circiter  $45^\circ$  divergentibus; petioli graciles, 1.5–2 cm. longi, initio villosito-tomentosi, tarde glabrescentes; stipulae lineari-lanceolatae vel subulatae, caducae. Flores (deflorati tantum visi) 5–8 in racemo umbelliformi; pedicelli post anthesin glabri, graciles, 1.5–3 cm. longi, cicatricibus bracteolarum notati; sepala deltoideo-ovata, acutiuscula, 2 mm. longa, extus glabra, intus dense villosa, post anthesin reflexa, verosimiliter demum decidua; petala orbiculario-ovata (unum tantum visum), 7–8 mm. longa, basi subcordata, unguiculo brevi, utrinque glabra; stamina circiter 20, 4–5 mm. longa; discus cupularis, glaber; styli 3, infra medium connati, toti glabri, stamina paulo superantes. Fructus desideratur.

CHINA. Honan: Sung Hsien, Shi-tze-miao, May 26, 1919, *Joseph Hers* (No. 489, type; No. 573); Teng Feng Hsien, Yu-tai-shan, alt. 800 m., April 23 and June, 1919, *Joseph Hers* (No. 222, 222bis, sterile); Hwei Hsien, Shang-lich-kiang, June 17, 1919, *Joseph Hers* (No. 725).

This is a very distinct species related to *M. kansuensis* with which it agrees in the structure of the flowers, particularly in the 3 glabrous styles and the triangular-ovate sepals, but the leaves are very different from those of *M. kansuensis* which are usually three-lobed or occasionally five-lobed, and resemble those of *M. yunnanensis* Schneid. The plant might be described as having the leaves of *M. yunnanensis*, but smaller and comparatively broader and acute, not acuminate, and the flowers of *M. kansuensis*. As the mature fruit is not yet known, it remains doubtful whether the calyx is deciduous or persistent.

Mr. Hers notes three different vernacular names for this plant; for no. 222: "ta-yeh-mao-cha" (large hairy leafy Crataegus); for 573: "sung-lo-cha" (meaning doubtful, sung-lo being the classical name of an undetermined vine, or as Bretschneider has it, a mistletoe); for nos. 489 and 725: "mu-hu-li" (fox pear).

***Malus coronaria* var. *dasycalyx*, var. nov.**

A typo recedit calyce villosa, foliis subtus pallidioribus, eis turionum maturis interdum ad costam et venas leviter pubescentibus.

OHIO. Lucas County: Maumee River bank, Walbridge Park, Toledo, May 21 and September 28, 1914, September 29, 1915, *R. E. Horsey* (No. 253, type); near Ottawa Park, Toledo, May 24, 1915, September 29, 1914, *R. E. Horsey* (No. 308); May 22 and September 29, 1914, same place and collector (No. 259). Lorain County: Oberlin, October 4, 1915, *R. E. Horsey & Grover* (No. 496). Harden County: Mt. Victory, May 16 and September 24, 1915, *R. E. Horsey* (No. 349). Franklin County: Columbus, May 17, 1914 and September 24, 1913, *R. E. Horsey* (No. 115). Clark County: Springfield, May 13, 1915, *R. E. Horsey* (No. 337).

INDIANA. Porter County: sand dunes 5 miles north of Chesterton, August, 1915, *C. C. Deam* (No. 18066). Noble County: 2 miles northwest of Wold Lake, May 14, 1919, *C. C. Deam* (No. 27458). Allen County: Godfrey Reserve, 3 miles south of Fort Wagner, May 14, 1919, *C. C. Deam* (No. 27479). Wells County: east of Bluffton, May 19, 1916, *C. C. Deam* (No. 19754); southeast of Bluffton, May 18, 1919, *C. C. Deam* (No. 27487). Whitley County: Loon Lake, May 14, 1919, *C. C. Deam* (No. 27474). Warren County: 2 miles south of Rainsville, May 10,

1919, *C. C. Deam* (No. 27356). Randolph County: 5 miles south of Winchester, May 18, 1919, *C. C. Deam* (No. 27498). Wayne County: Elliott Mill bog, 4 miles southeast of Richmond, May 18, 1919, *C. C. Deam* (No. 27499).

SOUTHERN ONTARIO: woods, Niagara, May 31, 1901, *J. Macoun* (Herb. Surv. Geol. Canada, No. 34405); Amherstburg, June 10, 1882, *J. Macoun* (Fl. Can. No. 81); Fort St. Detroit, May 23, 1869 (Herb. Wm. Boott); all three in Herb. Gray.

This variety seems to be restricted to the southwestern part of the Great Lakes region, its range extending from southern Ontario to central Ohio and to middle and northwestern Indiana and probably to northeastern Illinois.

The flowering specimens show some resemblance to *M. glaucescens* Rehder which is an Alleghanian species ranging from northwestern New York to northern Alabama, but they differ in the more or less villous calyx while the pedicels are glabrate and in the narrower and longer leaves less deeply lobed and less glaucescent; the adult leaves of vigorous shoots differ still more being less deeply lobed, green or only slightly glaucescent beneath and particularly toward the end of the shoots pubescent on the midrib beneath and borne on short, pubescent petioles; such leaves occur in *M. coronaria* but not in *M. glaucescens*.

*Malus coronaria* var. *dasycalyx* f. *Charlottae*, forma nov.

A typo varietatis recedit floribus semiplenis majoribus.

Hort. E. P. DeWolf, Waukegan, Illinois, June 1, 1919, and June 20, 1920, *E. P. DeWolf*.

This handsome double-flowered form was discovered about eighteen years ago by Mrs. Charlotte M. DeWolf, near Waukegan. It is the second double-flowered form known of American Crab Apples. From the well known Bechtel Crab, *M. ioensis plena*, it is easily distinguished by the characters in which *M. coronaria* var. *dasycalyx* differs from *M. ioensis*.

*Malus coronaria Charlottae* is apparently fully as handsome as the Bechtel Crab and will probably become like that form a favorite ornamental tree.

*Malus angustifolia* Mill. f. *pendula*, forma nov.

A typo recedit ramulis gracilibus pendulis.

FLORIDA. Gadsden County: River Junction, June 25, 1914, *T. G. Harbison* (No. 129).

According to Mr. Harbison this form is very conspicuous among other Crab Apples on account of its peculiar weeping habit. It should be introduced into cultivation, as it will prove probably a valuable ornamental tree.

*Malus bracteata* Rehder in Sargent, Trees & Shrubs II. 230 (1913); in Mitteil. Deutsch. Dendr. Ges. XXIII. 261 (1914). — *Pyrus bracteata* Bailey in Rhodora, XVIII. 155 (1916); Stand. Cycl. Hort. v. 2878 (1916). — *Malus redolens* Ashe in Bull. Charleston Mus. XII. 39 (1916).

*Malus bracteata* originally described from a tree in southeastern Missouri has according to recent extensive collections a much wider range which extends from North Carolina to northwestern Florida and west to southeastern Missouri and central Alabama. The chief characters of *M. bracteata* are



the obtuse or acute, serrate or serrulate never lobed leaves of the flowering branchlets and the slightly lobed rather broad leaves of the vigorous shoots, pubescent beneath at least on the veins. The mature leaves of the shoots resemble those of *M. ioensis* var. *Palmeri*, but that species differs in its tomentose calyx. From *M. lancifolia* which some forms of *M. bracteata* resemble it differs in the broader and thicker strongly veined and pubescent leaves of the shoots, which are in *M. lancifolia* thin and glabrous at maturity and those of the flowering branchlets acute or acuminate at the apex. It is perhaps most closely related to *M. angustifolia* from which it differs chiefly in the broader and larger serrulate or serrate, not crenate leaves usually rounded at base and of thinner texture and not turning brown in drying, like those of *M. angustifolia*. The persistent bractlets which form a conspicuous feature of the Missouri specimens are smaller and early deciduous in most other specimens.

*Malus ioensis* f. *plena*, comb. nov. — *Pyrus angustifolia* fl. *pleno* in Gard. Chron. ser. 3, XIII. 43, fig. 8 (1893). — *Pyrus coronaria* fl. *pleno*, l. c. xxv. 39, fig. 145 (1899). — *M. angustifolia plena* Hartwig in Mitteil. Deutsch. Dendr. Ges. xvi. 268 (1907). — *M. angustifolia* fl. *pleno* Morel in Rev. Hort. 1910, 60, tab. — Burvenich in Rev. Hort. Belg. xxxviii. 185, tab. (1912). — *M. coronaria* var. *plena* Schneider in Silva-Tarouca, Uns. Freil.-Laubg. 264 (1913). — *Pyrus coronaria* f. *plena* Voss in Putlitz & Meyer, Landlex. iv. 68 (1913). — *Pyrus coronaria ioensis* fl. *pleno* Kache in Gartenw. xviii. 477, fig. (1914). — *Pyrus ioensis flore pleno* Bean, Trees Shrubs Brit. Isls. II. 286 (1914). — *Pyrus angustifolia Bechtelii* Greening Nursery Co., Descript. Book, 31, fig. (191?).

This double-flowered form of *M. ioensis*, generally known as "Bechtel's Crab" was found near Staunton, Illinois, and was introduced into cultivation by E. A. Bechtel of Staunton about 1888 from a tree found wild northeast of Staunton and known to old settlers for about 40 years (see Garden Mag. xvii. 318 [1913]). Flowering specimens were sent to the Arboretum in 1892 by Mr. Bechtel under the name *Pyrus angustifolia* fl. *pleno*.

#### HYBRIDS

× *Malus robusta*, nomen nov. = *M. baccata* × *prunifolia* Koehne, Deutsch. Dendr. 260 (1893). — ? *Pyrus baccata* var. *cerasifera* Regel in Gartenfl. xi. 202, t. 364, figs. 1, 6 (var. *cerasiformis* in tab.) (1862). — *Pyrus cerasifera* Wenzig in Linnaea, xxxviii. 45 (1874), non Tausch. — *Pyrus cerasifera* var. *hyemalis* Wenzig, l. c. — *M. microcarpa turbinata* Carrière, Étud. Gén. Pomm. Microcarp. 71 (1883). — *M. microcarpa cerasiformis* Carrière, l. c. 72 (1883). — *M. microcarpa robusta* Carrière, l. c. 76 (1883). — *M. microcarpa jucunda* Carrière, l. c. 81 (1883). — *M. microcarpa macrantha* Carrière, l. c. 94 (1883). — *M. microcarpa kermesina* Carrière, l. c. 87, fig. 15 (1883); in Rev. Hort. 1885, 112, fig. 21. — *Malus cerasifera* Zabel in Beissner, Schelle & Zabel, Handb. Laubholz-Ben. 187 (1903), non Spach. — *Malus cerasifera coccinea* hort. apud Zabel, l. c. — *M. cerasifera*

*coccinea macrocarpa* hort. apud Zabel, l. c. — *M. cerasifera hiemalis* hort. apud Zabel, l. c. — *M. cerasifera jenensis* hort. apud Zabel, l. c. 188 (1903). — *M. cerasifera odorata* hort. apud Zabel, l. c. — *M. odorata* Hort. Gall. ex Zabel, l. c. (1903), pro synon.

This hybrid has been called by many recent authors *Malus* or *Pyrus cerasifera*, but *M. cerasifera* Spach as well as *Pyrus cerasifera* Tausch are synonyms of *M. baccata* var. *mandshurica* and not applicable to this hybrid. The numerous forms of this hybrid are also often found in gardens referred to *M. baccata* Borkh. or *M. prunifolia* Borkh. under various varietal names. Of the different specific names attributed by various authors to this hybrid or quoted as synonyms none seems to be applicable to it. *Malus sibirica* Borkh. is according to the author's description either a form of *M. pumila* Mill. or *M. astrachanica* Dum.-Cours. *Pyrus microcarpa* Wendl. (not *P. microcarpa* Spreng.) of which I have not been able to find the place of publication is cited by Roemer (Syn. Monog. III. 214 (1847)) as a synonym of *M. baccata*, while *M. microcarpa* Carr. is a collective name for all Apples with smaller fruit than those of the common cultivated Apple; it seems to have been first applied to *M. microcarpa fastigiata* (in Rev. Hort. 1879, 215) which is apparently a form of *M. pumila*. *Pyrus rubicunda* Hoffmanns. (*M. rubicunda* Roem.) is probably a form of *M. prunifolia* or of *M. sylvestris*. *Pyrus ceratocarpa* Wender. has been taken for a form of *M. prunifolia* (*M. prunifolia*  $\zeta$  *ceratocarpa* Roem.) and *P. sphaerocarpa* Wender. is probably *M. baccata* var. *mandshurica* Schneid. to which variety also *P. suaveolens* Wender. may possibly be referable.

To this hybrid belong many of the forms cultivated under the name "Siberian Crabs" and the "Red Siberian" (colored plate in Beach, Apples of New York, II. 264, tab.) may serve as a representative of this group. One of the oldest forms is probably "Biggs' Everlasting Crab" mentioned by Loudon who states that it was raised in the Cambridge Botanic Garden by Mr. Biggs from seed received in 1814 from Siberia.

× *Malus robusta* var. *persicifolia*, var. nov.

A formis aliis recedit praecipue foliis oblongo-lanceolatis, 5–7.5 cm. longis et 1.5–2.5 cm. latis. — Arbor parva ramis subrectis satis robustis, folia acuminata, basi cuneata, argute serrulata, ab initio fere glabra, maturitate subchartacea; petioli 1–1.5 cm. longi; flores albi; in alabastro leviter carneo suffusi, 2.5 cm. diam.; pedicelli 2–2.5 cm. longi, ut calyx glabri; fructus subglobosus, circiter 1.5 cm. diam., plerique calyce deciduo interdum parvo persistente coronati, flavi, colore rubro suffusi.

Cultivated at the Arnold Arboretum; received from the Veitchian Nurseries in 1913 as *Pyrus* sp. Purdom (No. 179); type specimens collected May 8 and August 26, 1918, preserved in the herbarium of the Arboretum.

This is a very distinct looking Apple with rather stout branches fairly closely set with narrow peach-like leaves; but presenting no striking ornamental qualities.

× *Malus adstringens* Zabel = *M. baccata* × *dasyphylla* Zabel in Beiss-

ner, Schelle & Zabel, Handb. Laubholz-Ben. 187 (1903) (= *M. baccata* × *M. pumila*). — ? *M. transcendens* [Hort. apud Nash] in Jour. New York Bot. Gard. xix. 195 (1918), nomen.

Zabel's name though published without description may be considered sufficiently fixed by the indication of the parentage and seems to be the oldest name for the hybrids between *Malus baccata* and *M. pumila*. *Malus adstringens* is similar to *M. robusta* and not always easily distinguished from it, particularly as ternary hybrids like *M. (baccata* × *prunifolia*) × *pumila* probably occur, but the generally more pubescent leaves, the shorter stalks of the flowers and fruits, the larger, often depressed fruits with more impressed calyx will distinguish this group of hybrids which is also included under the general term "Siberian Crabs." Forms like "Hyslop" (see Beach, Apples of New York, II. 257, tab.), "Transcendent" (Beach, l. c. 266, tab.) and "Martha" (Beach, l. c. 259, tab.) may serve as types of this group of hybrids which is from an economic point of view more important than the forms of *M. robusta*.

× *Malus sublobata*, comb. nov. (= *M. prunifolia rinki* × *Sieboldii*). — *Pirus Ringo sublobata* Zabel, Syst. Verz. Münden, 18 (1878), nomen. — *P. Ringo trilobata* Zabel, l. c. (1878). — *Malus Ringo a. sublobata* Dippel, Handb. Laubholz. III. 400 (1893). — *M. Ringo* × *Toringo sublobata* Zabel in Beissner, Shelle & Zabel, Handb. Laubholz. 188 (1903). — *M. Ringo* × *Toringo trilobata* Zabel, l. c. 189 (1903).

Arbor coma pyramidalis ramis suberectis vel adscendentibus, vel coma rotundata ramis patentibus; ramuli satis robusti, juniores tomentosi, demum glabrescentes, fusco-purpurei; gemmae perulis tomentosis partim glabrescentibus. Folia vernatione partim conduplicata, partim involuta, ea ramulorum brevium anguste elliptica vel elliptico-oblonga, 3.5–8 cm. longa et 2–3.8 cm. lata, breviter acuminata, basi cuneata, argute simpliciter serrata, rarissime lobis brevibus 1–2 instructa, initio utrinque villosito-tomentosi, supra mox glabra, subtus tomento persistenti tenui vestita; petioli 1–4 cm. longi, graciles, pubescentes; folia turionum late ovata ad oblongo-ovata, ad 8 cm. longa et ad 7 cm. lata, basi rotundata vel late cuneata, superiora plura vel pauca utrinque, vel uno latere tantum, infra medium lobo brevi acuto instructa, maturitate chartacea; petioli plerique 1.5–2 cm. longi. Flores 3–6, albo-rosei, 3.5–4 cm. diam.; pedicelli 1.5–2.5 cm. longi, ut calyx albo-villosi: lobi calycis anguste triangulari-lanceolati, circiter 7 mm. longi; petala ovalia, circiter 2 cm. longa, basi rotundata; styli 5 vel 4, raro 3, circiter 1 cm. longi, staminibus paulo longiores. Fructus subglobosus, 1.5–2 cm. diam., interdum leviter costatus, flavus, calyce persistente basi in tubum brevem connato coronatus vel interdum calyce deciduo.

Cultivated at the Arnold Arboretum under No. 3833-1, of unknown origin; type specimens collected May 25, 1916, and September 23, 1918, preserved in the herbarium of the Arboretum.

This is a very handsome tree of pyramidal habit, or in one form with a round head, conspicuous in autumn by its numerous yellow fruits. It has



the general appearance of a vigorous form of *M. robusta*, but the veneration of the leaves which at least on the upper part of vigorous shoots are distinctly lobed and the number of styles which varies to 4 and even to 3 show the influence of *M. Sieboldii*. Of the origin of our plants nothing certain is known; the form with the round head probably came up in a lot of mixed *Malus* seeds brought in 1892 by Professor Sargent from Japan. As it appears from the synonyms enumerated above, forms of similar origin had been cultivated by Zabel in the arboretum at Muenden, Germany, before 1878, but a plant received as *M. Ringo sublobata* from Spaeth's nursery near Berlin, Germany, in 1900, proved to be a form of *M. robusta*.

× *Malus Arnoldiana* Sargent in Arnold Arb. Bull. no. xxii. 2 (1912), nomen. — Dunbar in Garden Mag. xxx. 22. fig. (1919) (= *M. baccata* × *floribunda*.) — *M. floribunda* var. *Arnoldiana* Rehder in Moeller's Deutsch. Gärt. Zeit. xxiv. 27, 2 figs. (1909). — *Pyrus pulcherrima* var. *Arnoldiana* Bailey in Rhodora, xviii. 155 (1916); Stand. Cycl. Hort. v. 2875 (1916). — *Malus pulcherrima* var. *Arnoldiana* [Nash] in Jour. New York Bot. Gard. xix. 194 (1918).

When I described this handsome flowering Crab in 1909 as a variety of *M. floribunda*, I believed that *M. floribunda* was probably a hybrid of *M. baccata* and *M. Sieboldii*, but I now consider *M. floribunda* to constitute a species, being led to this change of opinion partly on account of the discovery of a similar wild form described as *M. floribunda* var. *spontanea* Koidz., and partly on account of the fact that the hybrid theory does not satisfactorily explain the characters of *M. floribunda*.

*Malus purpurea*, comb. nov. (= *M. atrosanguinea* × *M. pumila* var. *Niedzwetzkyana*). — *M. floribunda purpurea* Barbier & Cie. in Rev. Hort. 1910, 539. — *Pyrus Malus floribunda purpurea* R. C. Notcutt in Gard. LXXVIII, 220 (1914). — *Pyrus floribunda* × *P. Niedzwetzkyana* in Gard. Chron. ser. 3, LXII. 221, fig. 84 (1917). — This hybrid was offered to the trade in 1910 by Barbier & Cie. of Orléans, France, and was stated to be a hybrid between *M. floribunda atropurpurea* and *M. Niedzwetzkyana*, which seems to be correct judging from the characters of the plant. This makes it a ternary hybrid, as *M. atrosanguinea* is supposed to be a cross between *M. Halliana* and *M. Sieboldii*. From *M. pumila* var. *Niedzwetzkyana* it differs chiefly in the occasionally lobed, smaller and lustrous leaves, in the longer-pedicled flowers with oblong petals and partly 4 styles and in the smaller fruit with sometimes deciduous calyx; from *M. atrosanguinea* it differs in the purplish young leaves, the purplish wood, in the larger and darker colored flowers and in the much larger fruit with usually persistent calyx.

Besides this hybrid two other hybrids of *M. pumila* var. *Niedzwetzkyana* have been briefly described by Professor N. S. Hansen in a leaflet published by the Department of Horticulture of the South Dakota State College of Agriculture and Mechanic Arts, entitled Northern Novelties for 1920. One of these hybrids is called "Hopa Red-flower Crab" and *M. baccata* is stated to be the male parent; it will, therefore, have to be classified as a variety

of *M. adstringens*. The other hybrid is called "Red Tip Crab" and is a hybrid with a wild Crab from Elk River, Minnesota, as the female parent. As *M. ioensis* is the wild species of that region, this hybrid would be a variety of *M. Soulardii*.

#### *Docynia* Decne.

*Docynia docynioides*, comb. nov. — *Docynia Delavayi* Rehder in Sargent, Pl. Wilson, II. 296 (1915), pro parte, non Schneider. — *Malus docynioides* Schneider in Bot. Gaz. LXIII. 400 (1917).

CHINA. Southern Szechuan: "inter Kua-pie et Ta-tiao-ko," alt. 2700 m., May 23, 1914, *C. Schneider* (No. 1349, type); Chin-chi Hsien, mountain-side alt. 1300 m., August, 1908, *E. H. Wilson* (Arnold Arb. Exped. No. 2998); same locality, July, 1903, *E. H. Wilson* (Veitch Exped. No. 3493). Yunnan: Mengtsze, mountains west, alt. 1800–2000 m. *A. Henry* (Nos. 10036, 10036a).

In examining Schneider's type of *Malus docynioides* I find that there are 3–5 ovules in each cell and that it should, therefore, be transferred to *Docynia*, though the resulting combination is rather unfortunate. This new *Docynia* is so closely related to *D. Delavayi* that some botanists may possibly not consider it specifically distinct, as the two types, though looking very distinct, are apparently connected by intermediate forms. *Docynia docynioides*, however, may be readily separated from typical *D. Delavayi* by the absence of the dense white tomentum of the under side of the leaves, by the thinner, not persistent leaves often, particularly toward the apex, serrate or serrulate, by the smaller number of stamens, and apparently also by the smaller number of ovules, for Cardot (in Rev. Hort. 1918, 131) states that in Franchet's type the number of ovules in each locule is 8–10, not 4 as described by Franchet, and Cardot for this reason transfers the species to *Cydonia* (in which he includes *Chaenomeles*) as *C. Delavayi*, but even if the number of ovules should be ten, this would not be a sufficient reason to transfer the species to *Cydonia* or *Chaenomeles*, as it agrees in all other characters, particularly in the structure of the flowers, with the other species of *Docynia*. The number of ovules, too, in *Cydonia* and *Chaenomeles* is more than ten.

#### *Chaenomeles* Lindl.

× *Chaenomeles superba*, hybr. nov. (= *C. japonica* × *lagenaria*). — *Cydonia Maulei* var. *superba* Frahm in Gartenw. II. 214 (1898). — Rehder in Bailey, Cycl. Am. Hort. I. 427 (1900). — *Chaenomeles Maulei superba* Leichtlin apud Zabel in Beissner, Schelle & Zabel, Handb. Laubholz.-Ben. 128 (1903). — Rehder in Bailey, Stand. Cycl. Hort. II. 728 (1914). — *Cydonia Maulei* var. *atrosanguinea* Froebel apud Olbrich in Gartenw. IV. 270 (1900).

This handsome garden form is apparently a hybrid between *C. japonica* and *C. lagenaria*, as already suggested by Zabel (l. c., see above). It differs from *C. japonica* chiefly in the larger, but narrower, acute, more sharply serrate, darker green leaves and in the larger flowers of deep blood-red color, and from *C. lagenaria* in the pubescent young branchlets slightly verruculose the second year, in the smaller, generally obovate-oblong less finely

and closely serrate leaves and in the more upright and compact habit. There are several distinct forms in cultivation.

*C. superba* f. *alba*, comb. nov. — *Cydonia Maulei* var. *alba* Froebel apud Olbrich in Gartenw. iv. 270 (1900). — *Chaenomeles Maulei alba* Froebel apud Zabel in Beissner, Schelle & Zabel, Handb. Laubholz.-Ben. 182 (1903). — A form with white flowers.

*C. superba* f. *rosea*, comb. nov. — *Cydonia Maulei* var. *grandiflora rosea* Froebel apud Olbrich, l. c. — *Chaenomeles Maulei grandiflora rosea* Froebel apud Zabel, l. c. — A form with light rose-colored flowers.

*C. superba* f. *perfecta*, comb. nov. — *Cydonia Maulei grandiflora perfecta* Froebel apud Olbrich, l. c. — *Chaenomeles Maulei grandiflora perfecta* Froebel apud Zabel, l. c. — A form with larger and broader leaves and with scarlet flowers with sometimes 6-8 petals.

In the genus *Chaenomeles* I am not able to distinguish more than three well marked species: *C. sinensis* Koehne belonging to the section *Pseudocydonia* Schneider later considered a distinct genus by its author, and *C. japonica* Lindley and *C. lagenaria* of the section *Euchaenomeles*; the former Japanese and the latter Chinese. The following recently proposed species based on cultivated plants are apparently all forms of *C. lagenaria*: *C. angustifolia* Koidzumi in Jour. Coll. Sci. Tokyo, xxiv. art. 2, 97 (1913); *C. eugeniioides* Koidzumi in Tokyo Bot. Mag. xxix. 160 (1915); *C. trichogyna* Nakai in Tokyo Bot. Mag. xxx. 23 (1916); Fl. Sylv. Kor. vi. 42, t. 15 (1916); *C. cardinalis* (Carr.) Nakai in Tokyo Bot. Mag. xxxii. 145 (1918) and *C. eburnea* (Carr.) Nakai, l. c. They may be distinct enough to be ranked as varieties or forms, but as I have seen neither specimens nor plants of any of them I am not able to make a definite statement regarding their systematic standing.

### *Pyrus* L.

*Pyrus ussuriensis* Maxim. var. *hondoensis*, var. nov. — *Pyrus ferruginea* Koidzumi in Tokyo Bot. Mag. xxix. 158 (1915), non Hooker f. — *P. rufoferruginea* Koidzumi, l. c. 311 (1915). — *P. aromatica* Kikuchi & Nakai in Tokyo Bot. Mag. xxxiii. 33 (1918). — *P. hondoensis* Kikuchi & Nakai l. c. 34 (1918).

HONDO. Mountainous parts near Tonomachi, Kamiheigun, Iwate pref., May 20, 1918, *K. Yamagishi*; same locality, same date, *K. Kikuchi*; mt. near Aidomura, Iwakigun, Fukushima pref., August 22, 1918, *S. Akiyama*; Ajara Mt. near Kuratatemura, Minamitsugarugun, Aomori pref., August 30, 1918, *A. Kikuchi*; about three miles from Yamagatamura, Minamitsugarugun, Aomori pref., August 22, 1914, *A. Kikuchi*; Fujisan, above Subashiri, alt. 1167 m., June 1918, *E. H. Wilson* (No. 10375; tree 5 m.); Soihimura, Chiisagatagun, Naganoken, May 23, 1918, *A. Kikuchi*; Kogoyama, prov. Kai, and Yamanaka, prov. Kai, *T. Komiyama*.

This variety differs from the type chiefly in the more elongate, ovate to ovate-oblong leaves with closer and finer, more appressed and less aristate serration, in the longer pedicels of flowers and fruits and in the often present brown floccose tomentum of the young branchlets and leaves and



of the inflorescence. The tomentose form described as *P. subferruginea* which scarcely differs from *P. aromatica*, may possibly be kept as a distinct form of the var. *hondoensis*, while the type of the variety represents the glabrescent or glabrous form. In Korea and particularly in southern Korea a form with longer pedicels occurs, but the shape and serration of the leaves is that of typical *P. ussuriensis*.

*Pyrus ussuriensis* var. *ovoidea*, var. nov. — *P. ovoidea* Rehder in Proc. Am. Acad. L. 228 (1915); in Moeller's Deutsch. Gaertn.-Zeit. xxxi. 102, fig. 2 (1916). — Nakai, Fl. Sylv. Kor. vi. 48, t. 17 (1916). — Bailey, Stand. Cycl. Hort. v. 2869, fig. 3278 (1916).

The addition of the var. *hondoensis* to *P. ussuriensis* has lessened the differences between *P. ovoidea* and *P. ussuriensis* and there remains now only the shape of the fruit which can hardly be considered a specific character in *Pyrus*. It therefore seems necessary to reduce *P. ovoidea* to a variety of *P. ussuriensis*.

To *P. ussuriensis* as synonyms or varieties belong probably the following recently published species based mostly on cultivated plants: *P. acidula* Nakai in Tokyo Bot. Mag. xxx. 27 (1916); Fl. Sylv. Kor. vi. 49, t. 18 (1916). — *P. Maximowicziana* Nakai, l. c. 50, t. 20 (1916). — *P. macrostipes* Nakai, l. c. 28 (1916); l. c. 52, t. 22 (1916). — *P. vilis* Nakai, l. c. 28 (1916); l. c. 51, t. 21 (1916). — *P. crassipes* Kickuhi & Nakai in Tokyo Bot. Mag. xxxii. 35 (1918). — *P. obovoidea* Koidzumi in Tokyo Bot. Mag. xxxiii. 123 (1919). — *P. insueta* Koidzumi, l. c. 123 (1919). — *P. tremulans* Koidzumi, l. c. 126 (1919). — *P. insulsa* Koidzumi, l. c. 127 (1919). — *P. iwatensis*, Koidzumi, l. c. 127 (1919). — *P. nambuana* Koidzumi, l. c. 128 (1919). — *P. jucunda* Koidzumi, l. c. 128 (1919).

*Pyrus serrulata* Rehder in Proc. Am. Acad. L. 234 (1915); in Sargent, Pl. Wilson. ii. 263 (1915); in Moeller's Deutsch. Gaertn.-Zeit. xxxi. 111, fig. 7 (1916). — Bailey, Stand. Cycl. Hort. v. 2870 (1916).

From the specimens collected by Wilson in China this species was described as having 3-4 styles and a deciduous calyx, but plants raised at the Arboretum from seed collected at the same time in China produced flowers with usually 4, very often 5, but very rarely 3 styles and with partly persistent and partly deciduous calyx; between the number of styles or locules and the behavior of the calyx there seemed to be a slight correlation in so far as a larger percentage of the fruits with deciduous calyx had five locules. The few fruits, too, of a specimen collected by Professor L. H. Bailey at Kuling, Kiangsi, in 1917, which otherwise looks like *P. serrulata*, shows five styles and persistent calyx. Whether the variation in the number of styles and in the behavior of the calyx indicates hybrid origin of *P. serrulata* or simply a tendency of the species to vary, I am not yet prepared to say. In species with normally deciduous calyx it occurs sometimes, as I have observed in *P. betulifolia*, *P. Calleryana* var. *Fauriei* and in *P. pashia*, that the calyx wholly or partly persists, but in this case the fruits often do not seem to be quite normal and sometimes are seedless.

***Pyrus Calleryana* Decne. f. *graciliflora*, forma nov.**

A typo recedit ramulis apicem versus tomento canescenti denso ad secundum annum persistente vestitis, basin versus glabris, floribus minoribus circiter 2 cm. diam., staminibus dimidia petala superantibus, antheris roseis. — Arbor: folia ab initio glabra margine tantum villosa: inflorescentia glaberrima, 7–10-flora, laxa; pedicelli 1.5–2.5 cm. longi; styli fere semper 2.

Cultivated at the Arnold Arboretum; raised from seed collected by Mr. E. H. Wilson, at Patung Hsien, Hupeh, in 1907; type specimens collected May 6, 1919, preserved in the herbarium of the Arboretum.

This form looks at flowering time quite distinct from the plants we consider typical *P. Calleryana* on account of its looser and slenderer inflorescence and the smaller flowers with pink, not purple anthers.

***Pyrus Calleryana* f. *tomentella*, forma nov.**

A typo recedit ramulis junioribus dense albo-tomentosis, annotinis glabrescentibus vel glabris, foliis initio tomento floccoso obtectis mox glabris costa media utrinque villosa excepta, saepe, praesertim eis turionum, argutius serrulatis nec crenato-serrulatis, inflorescentiis, pedicellis calycibusque albo-villosis.

Cultivated at the Arnold Arboretum; raised from seed collected by Mr. E. H. Wilson in Hupeh in 1907; type specimens collected May 10 and September 22, 1918, preserved in the herbarium of the Arboretum.

This form is readily distinguished from the type by the dense white tomentum of the young growth and of the inflorescence, which on the branchlets often persists until the following year.

***Pyrus Calleryana* var. *Fauriei*, Nakai mscr. in. sched. Herb. Imp Univ. Tokyo ex Nakai in Toyko Bot. Mag. xxx. 30 (1916), pro synon. — *P. Fauriei* Schneider, Ill. Handb. Laubholz. i. 666, fig. 363d' (1906); in Fedde, Rep. Sp. Nov. iii. 121 (1906). — Rehder in Proc. Am. Acad. L. 238 (in nota) (1915). — Nakai in Coll. Sci. Tokyo, xxvi. art. 1, 182 (Fl. Kor. i.) (1909); Fl. Sylv. Kor. vi. 54, t. 24 (1916).**

KOREA. Prov. Keiki: mountain slopes near Keijyo (Seoul), September 23, 1918, *E. H. Wilson* (No. 10743; shrub 1–2 m.; fruit russet spotted); Seoul, May 1901, *U. Faurie* (No. 78, type, ex Schneider); “Syon Ouen, circa sepulturam,” May 30, 1906, *U. Faurie* (No. 310); Kazan near Suigen, May 24, 1917, *E. H. Wilson* (No. 8480; tree 8 m.); same locality, September 2, 1917, *S. Tokuda*.

Judging from the specimens before me *P. Fauriei* is only a variety of *P. Calleryana*, smaller in all its parts than the type; the leaves are sometimes broadly cuneate at base and rather thin.

***Pyrus Kawakamii* Hayata in Jour. Coll. Sci. Tokyo, xxx. art. 1, 99 (1911); Icon. Pl. Formos. i. 243 (1911). — *P. Koehnei* Koidzumi in Jour. Coll. Sci. Tokyo, xxxiv. art. 2, 57 (1913), pro parte. — Rehder in Proc. Am. Acad. L. 238 (1915), quoad plantam Formos., non Schneider.**

FORMOSA. Kyoshiro, prov. Nanto, road-side, alt. 667m., February 11, 1918, *E. H. Wilson* (No. 9835; bush 4 m.); same locality, thickets, November 4, 1918, *E. H. Wilson* (No. 10876; tree to 10 m.); in garden of Chinese at Sozon, prov. Taikoku, October 11, 1918, *E. H. Wilson* (No. 10785; tree 5 m.).

This species had been referred as a synonym to *P. Koehnei* by Koidzumi



and I followed him having seen at that time no specimens of either species. Now I have before me flowering and fruiting material of the Formosan plant and find that the flowers are quite different from those of *P. Koehnei*; the calyx-lobes are short, ovate and obtuse or obtusish, the number of styles is 3 in the several flowers examined and the peculiar construction of the disk in *P. Koehnei* as figured by Schneider is not present. The species is much nearer to *P. Calleryana* and may be only a variety of it; it differs chiefly in the ovate, obtuse or obtusish, not deltoid and acute calyx-lobes, in the broadly elliptic to elliptic-oblong, more coriaceous leaves usually cuneate not rounded at base and more deeply and sharply crenate-serrulate, though similar leaves may be found on specimens of *P. Calleryana* from Kwangtung. The young leaves, the pedicels and the outside of the calyx are quite glabrous.

× *Pyrus congesta*, hybr. nov. (= *P. betulifolia* × *elaeagrifolia*).

Arbor ramis patentibus ramulis subpendentibus junioribus cinereo-tomentosis tomento ad secundum et partim ad tertium annum persistente. Folia ovata vel elliptico-ovata ad elliptico-lanceolata, acuminata vel minora acuta, basi rotundata vel cuneata, 3-6 cm. longa, ea turionum semper anguste elliptica ad elliptico-lanceolata, basi cuneata et ad 7 cm. longa, basi excepta argute serrulata, initio utrinque, supra laxius tomentosa, demum supra costa media villosa excepta glabra, intense viridia, lucida, subtus pallidiora tomento tenui oblecta, nervis utrinque elevatis conspicuis sub angulo circiter 45° divergentibus; petioli 0.5-2.5 cm. longi, graciles, tomentosi. Flores 6-9 in umbella satis densa 3-5 cm. diam., albi, 2-2.5 cm. diam.; pedicelli 0.5-2 cm. longi, ut calyx villosus-tomentosus; calycis lobi triangulari-ovata, obtusiuscula, 1.5-2 mm. longa, reflexa, utrinque villosa, dimidium tubum aequantes; petala ovalia, 0.8-1.2 cm. longa; stamina 25-30, petala dimidia aequantia; styli 3-4, rarissime 5, basi sparse pilosi vel fere glabri, staminibus breviores. Fructus subglobosi, 3-9 in umbella congesta, 1-1.5 cm. diam., brunnei, punctulati, pedicellis robustis 0.5-1.5 cm. longis suffulti, calyce persistenti lobis reflexis coronati; semina 6 mm. longa, obovoidea.

Cultivated at the Arnold Arboretum, of unknown origin, probably from seed collected in the Arboretum; type specimens collected May 13, 1909, and September 30, 1913, are preserved in the herbarium of the Arboretum.

This hybrid resembles most *P. betulifolia* Bunge from which it chiefly differs in the finely serrulate narrower leaves, those of the shoots mostly elliptic-lanceolate and cuneate at the base, tomentose on both sides when unfolding and with permanent tomentum beneath, in the larger short-stalked flowers with 3-4 or rarely 5 styles and in the larger fruit with persistent calyx. The other parent is apparently *P. elaeagrifolia* of which there was a tree near the *P. betulifolia* from which the seed was probably taken. From that species it is easily distinguished by the broader serrulate leaves, the 3-4 styles, only very rarely 5, and the smaller fruit in dense clusters of from three to nine.

(To be continued)



## NOTES

**Strutt's Sylva Italica.** The Arboretum has lately obtained a copy of the *Sylva Italica*; or Portraits of Forest Trees in Italy, distinguished by their Antiquity, Magnificence or Historical interest, drawn from nature and etched by Jacob George Strutt, and published by Dickinson & Son, 114 New Bond Street, London, and by the author, 52 Via Babuino, Rome. Like the *Sylva Britannica* by the same author it is a folio, and it consists only of part 1 containing the descriptions and portraits of four trees. The *Sylva Italica* appears to be a rare book. It is not mentioned in the *Bradley Bibliography*; it is not in the catalogue of the British Museum (Natural History), the catalogue of the library of the Royal Gardens at Kew or in that of the Department of Agriculture of the United States.

Plate 1 represents Tasso's Oak standing in the garden of the Convent of Sant' Onofrio in Rome founded in 1491. Although the author does not mention the fact, this tree is *Quercus Ilex*. It was still standing in 1906, but a photograph in the Arboretum collection taken in that year shows that it had lost many branches in the great storm of September 20, 1842, and was apparently in poor health.

No. 2. Cypresses in the garden of the Villa d'Este at Tivoli. These are *Cupressus sempervirens* var. *fastigiata* and, according to Strutt, "the largest of these trees measures sixteen feet eight inches in circumference at five feet from the ground and is about one hundred and ten feet in height."

No. 3. The Colonna Pine in the garden of the Colonna Palace in Rome and planted by the Colonna Family in 1332 "as a lasting memorial of their vengeance, by the death of Cola di Rienzi, for the slaughter of three of their kinsmen at the gate of San Lorenzo, during the contest that existed between the Tribune and the haughty nobles of Rome." Strutt's portrait represents a magnificent specimen of *Pinus pinea*. He gives the height as about one hundred and twenty feet and the circumference of the trunk at five feet from the ground as twenty-one feet four inches.

No. 4. Michael Angelo's Cypresses. "These magnificent trees," we are told, stand "in the large court of the Carthusian Convent of Santa Maria degli Angeli, which together with the noble church adjoining were constructed by Michael Angelo on the site of the ruins of the Baths of Diocletian." These trees (*Cupressus sempervirens* var. *fastigiata*) are said to have been planted by Michael Angelo and to have been originally four in number. Three of the original trees appear in Strutt's engraving; the fourth, which he says had been destroyed by lightning, had been replaced by a young Cypress of the same variety. Strutt gives the circumference of the largest of these trees at five feet from the ground as thirteen feet eight inches and the height of the tallest ninety-five feet.

**Famous Trees of Korea.** The Arboretum has recently received from the Right Reverend Mark Napier Trollope, Episcopal Bishop of Korea, an

interesting record of Korean trees famous for their size, age or historical associations, published by the Government General of Chosen. The work is in Japanese and its value in the Arboretum library is increased by the following description which the Bishop has appended to the volume.

"This book was published by the Government General of Chosen in April 1919, and consists of 197 pages, of which 181 are occupied with particulars of the famous trees, followed by an appendix of miscellaneous notes occupying 16 pages. The whole is preceded by twelve pages of illustrations, a page of introduction and four pages of Index or 'Contents.' The trees depicted in the twelve illustrations are —

1. Keyaki (*Zelkova*).
- 2, 3. Ichō (*Ginkgo*).
- 4, 5. Akamatsu (*Red Pine*).
6. Enjū (*Sophora japonica*).
7. Haru nire (*Elm*).
- 8, 9, 10. Byakushin (*Chinese Juniper*).
11. Shiromatsu (*White Pine*).
12. Kaya (*Yew*).

"It is difficult to see in some of the above cases why they should have been specially selected for illustration in preference to other and finer specimens.

"The information throughout is given in Japanese exclusively, except that (a not always happy) attempt is made in most cases to supply the Korean vernacular name of the tree in question in Korean script. The height measurements purport to be given in ken, a Japanese measure amounting to about 6 feet. But in some cases it is plain that the number of feet has been given instead of the number of ken. For example a Chinese Juniper (No. 14 in § 13) on p. 155 is given as being 25 ken (about 150 feet) tall, whereas it certainly does not exceed 25 or 30 feet.

"The trees, of which particulars are given in the main part of the book (pp. 1-181) are 3188 in number, arranged according to species in 64 sections.

"The information with regard to each tree is given in nine columns, of which the first (at top of page) gives the number of the tree or the list, the second and third give the precise locality, the fourth gives the ownership, the fifth gives the girth of the trunk (in feet) at 5 feet from the ground, the sixth gives the height of the tree, the seventh gives its age, the eighth gives the tree's character or title to special care or notice, the ninth adds notes as to the historical associations of the tree or its connection with local superstitions, traditions or religious observances."

This volume makes an important supplement to the volume published in 1913 on the Old and Famous Trees in Japan by Suroku Honda, the distinguished and best known Japanese landscape gardener, professor in the Imperial University of Tokyo.